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MISSISSIPPIAN LIMESTONE RESOURCES IN FULTON, MCDONOUGH, AND SCHUYLER COUNTIES, ILLINOIS

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ABSTRACT

Fulton, McDonough, and Schuyler Counties lie in western Illinois and are underlain principally by Pennsylvanian sandstones and shales. In some places where erosion has cut through these beds, limestones of Mississippian age, chiefly the Burlington, Keokuk, Salem, and St. Louis Formations, are exposed. Because they are the thickest limestones in the area, they are of significance as commercial sources of crushed stone. All the outcrops of Mississippian limestone that could be found, totaling 97 in number, are described. Fourteen detailed chemical analyses, 73 acid solubility tests, and 10 physical tests give information regarding the character of the limestones. Outcrops rarely exceed 25 feet thick, are most abundant in Schuyler County and fewest in Fulton County.

INTRODUCTION

Fulton, McDonough, and Schuyler Counties are located in western Illinois (fig. 1). The surficial deposits of the area are mainly brown clayey silt above a gray or brown pebbly clay. The bedrock throughout most of the area is principally of Pennsylvanian age and consists largely of sandstone and shale with a few thin limestones, usually less than 5 feet thick. Coal is mined in places. The chief present and potential sources of limestone in the counties are the Burlington, Keokuk, Salem, and St. Louis Limestones of Mississippian age that underlie the Pennsylvanian beds and crop out along many of the major streams and their tributaries. Some of the limestone deposits are comparatively thick. These limestones are used for road material, agricultural limestone, and aggregate.

Information regarding the outcrops of the Burlington, Keokuk, St. Louis, and Salem Limestones in the area of investigation is given in a number of reports: Bleininger, et al. (1912), Hinds (1919), Krey and Lamar (1925), Morse and Kay (1915), Savage (1921), Savage and Nebel (1921), Wanless (1957), and Worthen, et al. (1870; 1873).

It is the purpose of this investigation to assemble all information regarding Mississippian limestone resources in this report area, to examine and describe the present condition of the outcrops mentioned, to discover new outcrops, and to obtain and test samples from those deposits that appear to have possible commercial significance. The available well record data also were studied for information regarding areas of shallow limestone.

LIMESTONE QUARRYING INDUSTRY

The products of the quarries in the counties covered by this report include aggregate for roads and concrete, agricultural limestone, and riprap.

At present there are no quarries operating in Mississippian limestones in Fulton County, although in recent years the Seville Rock Company operated a quarry in the St. Louis Limestone, about one mile southwest of Seville in the NE¼SW¼NE¼ sec. 26, T. 6 N., R. 1 E. The thickness of limestone quarried varies from approximately 15 to 20 feet. The limestone has an overburden of about 15 to 45 feet, which consists of about 8 feet of interbedded sandstones, siltstones, shales, and coals, plus 10 to 37 feet of unconsolidated materials. Two quarries are currently operating in McDonough County: the Colchester Stone Company (fig. 3, M 3), 2 miles northwest of Colchester in the SW¼NW¼ sec. 11, T. 5 N., R. 4 W; and McClure Quarries, Inc. (fig. 3, M 2), 2½ miles northwest of the same town in the SW¼ NE¼ sec. 10, T. 5 N., R. 4 W. Both quarry St. Louis Limestone, which is 25 to 30 feet thick. Overburden varies but is generally about 10 feet of sandstone, shale, and clay, plus 5 to 10 feet of silt and soil.

Two quarries are operating in Schuyler County: the Elas Quarry in the SE¼ SE¼ NW¼ sec. 32, T. 2 N., R. 1 E., and the Jones Quarry in the SW¼NE¼ sec. 5, T. 1 N., R. 1 E., 2½ and 1½ miles north of Frederick, respectively. Both operations are in the St. Louis Limestone, which is 15 to 22 feet thick. The upper 6 to 10 feet in each pit are brecciated, that is, the strata consists of angular, interlocking fragments of limestone. The lower beds are mostly fine grained and even textured limestone. Overburden in the area is variable in thickness and ranges from 20 to

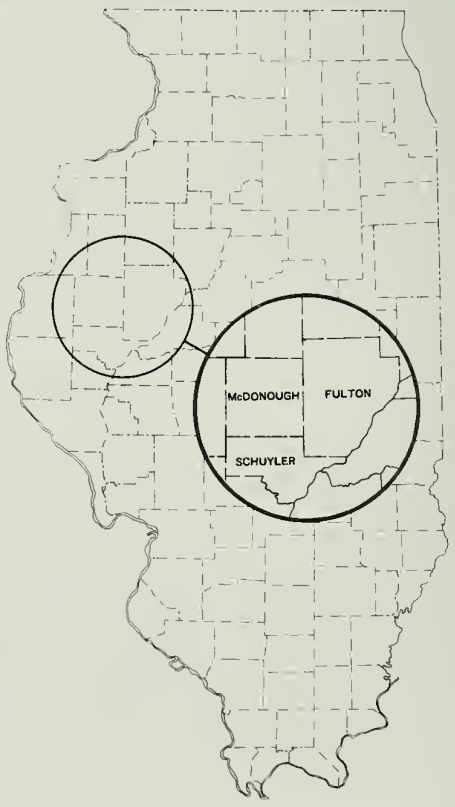

Figure 1 - Location of Fulton, McDonough, and Schuyler Counties.

60 feet in the hillslopes on both sides of Sugar Creek. It mainly consists of unconsolidated silts and sands and variable thicknesses of Pennsylvanian strata.

The Missouri Gravel Company periodically produces rock from their Damon Quarry in Schuyler County, 4 3/4 miles directly southwest of Camden in the $E\frac{1}{2}SE\frac{1}{4}$ sec. 34, T. 2 N., R. 4 W., on the southeast side of Missouri Creek. Twenty-one to twenty-six feet of limestone and dolomitic limestone are worked. The upper 20 to 24 feet are St. Louis Formation, and the lower $1\frac{1}{2}$ to 2 feet are probably Salem. The St. Louis is mainly fine grained, dense, and jointed. In many places the limestone is brecciated and very large fragments are relatively common. Overburden at the Damon pit and surrounding area consists of (in ascending order) 10 feet of shale, 3 feet of sandstone, 3 feet of shale, and 10 to 12 feet of pebbly clay and silt. The chemical analysis of sample S represents the entire quarry face and is shown in table 1.

SAMPLES AND TESTS

Samples for testing and analysis were obtained by collecting fist sized pieces from quarry faces or outcrops at regular vertical intervals. If the deposits were cherty, a proportionate amount of chert was included in the sample. In general, these samples are believed to represent the rock with reasonable accuracy; but in the case of the brecciated St. Louis Limestone, its great variability makes representative sampling difficult, and a single set of samples is only an approximation of the whole deposit. In preparation for chemical tests, samples were crushed and ground to yield representative fractions passing 60 mesh. All chemical elements reported, except CO_2, were determined by X-ray fluorescence methods (table 1).

The calcium carbonate equivalent (abbreviated C.C.E.) was determined by titration. This test measures the acid neutralizing capacity of the stone and is sometimes referred to as: calcium content, lime content, or test. The calcium carbonate equivalent for pure limestone is 100 percent, but for pure dolomite, it is 108.6 percent because the magnesium carbonate in the dolomite has a greater neutralizing capacity than an equivalent weight of calcium carbonate. A close approximation to the calcium carbonate equivalent may be obtained, in the case of limestones, especially those that are relatively pure, by the acid solubility test. A weighed amount of limestone is dissolved in hydrochloric acid, and the insoluble residue, the amount that did not dissolve, is determined. From this, the amount that dissolved can be calculated in terms of percent. In the case of dolomite, the acid solubility test gives percent solubility figures that are likely to be somewhat lower than the calcium carbonate equivalent. Results of calcium carbonate equivalent and acid soluble tests are given in table 2.

A representative fraction of each sample was ground further to pass 200 mesh. An X-ray analysis of the powder was made to determine the quartz content. This was done by comparing the intensity of the diffraction peak from quartz in the samples to that from standardized calibration curves of quartz-calcite and quartz-dolomite mixtures. These results (table 2) have a possible relative error of about 10 percent of the amount reported.

Physical tests for abrasion resistance and soundness were made in accordance with ASTM Designation: C 131, for the Los Angeles abrasion test, and ASTM Designation: C 88, for the sodium sulphate soundness test. Results of tests on samples representing the three main rock types of the Mississippian limestones from three of the better exposures in the area are given in table 3.

TABLE 1 - CHEMICAL ANALYSES OF LIMESTONES AND DOLOMITES
(Analyses by Juanita Witters and David B. Heck, Illinois State Geological Survey)

Sample No.	County	Near	Formation	Thickness (feet)	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	CO_2	Total	$CaCO_3$*	$MgCO_3$*
F 4a	Fulton	Seville	St. Louis		13.8	1.22	0.46	0.8	48.2	37.20	101.68	86.0	1.7
F 6	Fulton	Seville	Salem	4.0	4.4	0.79	6.65	12.4	35.6	40.40	100.24	63.5	25.9
M 10b	McDonough	Tennessee	Salem	14.5	11.6	1.72	5.19	12.8	30.2	38.41	99.92	53.9	26.8
M 10c	McDonough	Tennessee	St. Louis	10.0	6.7	0.78	0.36	0.2	52.2	40.49	100.73	93.2	0.4
M 15	McDonough	Tennessee	St. Louis	25.0	2.8	0.37	0.33	0.5	53.3	42.64	99.94	95.1	1.0
M 18	McDonough	Colmar	Burlington-Keokuk	13.5	9.2	0.58	0.22	0.9	48.8	39.41	99.11	87.1	1.9
M 18b	McDonough	Colmar	Burlington-Keokuk	7.0	20.2	0.54	0.59	0.7	43.8	34.66	100.49	78.2	1.5
M 23a	McDonough	Colmar	St. Louis	17.0	3.5	0.30	0.24	0.2	53.4	42.13	99.77	95.2	0.4
M 23b	McDonough	Colmar	St. Louis	3.0	5.6	0.72	4.68	11.2	37.3	40.92	100.42	66.6	23.4
S 19a	Schuyler	Brooklyn	Salem	18.8	2.0	0.20	4.45	15.8	32.2	44.13	98.78	57.5	33.0
S 26	Schuyler	Huntsville	St. Louis	20.7	4.4	0.57	0.67	0.8	52.3	41.57	100.31	93.3	1.7
†S	Schuyler	Camden	St. Louis	23.0	2.8	0.36	0.87	2.0	50.7	42.65	99.38	90.4	4.2
S 29	Schuyler	Camden	St. Louis	14.0	2.4	0.34	3.86	7.9	44.2	42.93	101.63	78.9	16.2
S 46d	Schuyler	Ripley	Salem	7.0	3.3	0.41	0.41	0.7	53.7	42.12	100.64	95.8	1.5
‡C 30	Schuyler	Ripley	St. Louis	4.0	4.14	1.88		0.66	51.86	**41.46	100.00	92.53	1.38
C 31	Schuyler	Ripley	St. Louis	5.0	11.88	3.84		0.48	46.46	**37.76	100.42	82.90	1.00
C 32	Schuyler	Ripley	Salem or St. Louis	8.0	15.04	6.44		1.34	42.46	**35.66	100.94	75.76	2.80
C 34	Schuyler	Camden	St. Louis	8.0	4.14	3.08		2.24	49.70	**42.04	101.20	88.68	4.68
C 35a (S 39)	Schuyler	Camden	Burlington-Keokuk	7.0+	9.30	4.54		0.42	47.98	**38.84	101.08	85.61	0.88
C 35b	Schuyler	Camden	Burlington-Keokuk	11.0	15.80	5.88		6.84	36.00	**36.92	101.44	64.23	14.30
C 36	Schuyler	Camden	Salem or St. Louis	—	11.30	6.16		2.72	43.22	**38.06	101.46	77.11	5.68
C 37	Schuyler	Brooklyn	St. Louis	9.0	6.58	2.70		0.42	50.60	**40.66	100.96	90.29	0.88

* Calculated from CaO and MgO

† Damon quarry, Missouri Gravel Company

‡ All analyses prefixed by C are from Bleininger et al., 1912, p. 99-100

** Loss on ignition

MISSISSIPPIAN FORMATIONS

In Fulton, McDonough, and Schuyler counties, the Mississippian limestones that are potentially of interest for quarrying are the St. Louis, Salem, Burlington, and Keokuk Limestones. Table 4 shows the succession of the limestones and related materials and their general character. Other Mississippian formations exposed are the Warsaw Shale and the Sonora Sandstone.

All the Mississippian limestones are considered to have been deposited in an ancient sea. Subsequent to the deposition, western Illinois became land, and streams cut irregularly into the limestone deposits. When the ocean again invaded the area, the Pennsylvanian deposits it laid down rested on Keokuk and Burlington Limestones in some places and on the Warsaw, Salem, or St. Louis Formations in other places, depending on how much these Mississippian rocks had been eroded when they were land. In similar fashion, the Burlington Limestone is considered to rest on an underlying shale whose surface is irregular (Wanless, 1957, p. 45).

Only a few true dolomites, that is, rocks composed principally of the mineral dolomite, were in the counties; however, limestones that contain a noteworthy amount of the mineral dolomite were common, especially in the Salem Formation. These rocks are referred to as dolomitic limestones.

Burlington-Keokuk Limestones

In the area of this report, the Burlington and Keokuk Limestones cannot be readily differentiated and hence are considered as a single unit. These limestones are believed to underlie the area at varying depths, but outcrops are restricted to the southwestern corner of McDonough County and the vicinity of Birmingham and Camden in Schuyler County.

The Burlington-Keokuk Limestones are overlain by Warsaw Shale except in the immediate vicinity of outcrops where the shale has been eroded and in northern Fulton County where the limestones are capped by Pennsylvanian rocks. The formations consist of well bedded, light gray or buff, fine- to coarse-grained, fossiliferous limestones, in beds ranging from a few inches to two feet or more thick. Dolomitic limestone beds occur in places. Some of the strata are separated by thin clay or shale partings and/or beds. Nodular and lenticular masses of chert are common.

The Burlington-Keokuk Limestones are as much as 180 feet or more thick. The greatest exposed thickness, which was seen in the counties being considered, was 25.5 feet, but 75 or more feet were observed in the R. and L. O'Neal and Sons Quarry, near Plymouth in adjacent Hancock County.

The chemical composition of the Burlington-Keokuk Limestones varies (tables 1 and 2). None of the samples tested exceeded 91 percent carbonates. In general, the impurities in the samples were silica, present as chert, which is characterictic of most of the formation. However, some outcrops of limestone described in the appendix, especially the one sampled in an abandoned quarry near Colmar (sample M 18), contain lesser amounts of chert. These outcrops might be sources of agricultural limestone and meet chemical specifications for limestone used in the manufacture of Portland cement provided that the amount of contained chert and its abrasiveness to crushing and grinding equipment do not prohibit economical quarry operations.

Physical tests on sample M 18 (table 3), indicated that the soundness and abrasion of the sample was slightly higher than the Illinois requirements for aggregate

TABLE 2 — HYDROCHLORIC ACID SOLUBILITY, CALCIUM CARBONATE EQUIVALENT, AND QUARTZ CONTENT OF LIMESTONES AND DOLOMITES

Sample number	Thickness	Acid soluble percent	C.C.E. percent	Quartz content, percent
	FULTON COUNTY			
F 1	6 ft		94	6
F 2	3	98		2
F 3	10.5	96		—
F 4	—		50	45
F 4a	—		83	16
F 5	7		89	11
F 6	4	95		3
F 7	15		69	27
F 8	5	83		9
F 9	2		93	2
	MC DONOUGH COUNTY			
M 1	25		85	17
M 5	4		94	1
M 6	4	79		16
M 7	17		95	4
M 9	25 ±		97	2
M10b	14.5		79	15
M10c	10.5		94	3
M11	9		87	12
M12	8		93	6
M13	8	95		3
M14	8		93	4
M15	25		96	3
M16	7	63		18
M17	4	91		8
M18	13.5		90	9
M18b	7		79	20
M22a	10		68	32
M22b	9		84	10
M23a	17	96		3
M23b	3	93		4
M24	7	96		4
M25	13	91		6
M26	2		93	6
	SCHUYLER COUNTY			
S 2a	9	91		4
S 2b	21	97		1
S 5	13	89		9
S 6	5.5	89		8
S 7	5	96		2
S 8	6	96		2
S 9	12	94		—
S 9a	14	81		—
S10	13	89		11
S11	1.5	63		—
S12	13	97		2
S13b	13	94		5
S13a	5	73		—

Sample number	Thickness	Acid soluble percent	C.C.E. percent	Quartz content, percent
	SCHUYLER COUNTY Cont.			
S15	7 ft	90		10
S16	13	88		12
S17	12	84		9
S18	4.5	84		9
S19a	18.8	98		2
S19b	5	98		2
S22	35		92	6
S23	2	83		—
S23a	19	97		—
S24a	16	83		15
S24b	1.5	96		3
S24c	4	84		16
S26	20.7	93		—
S29	14	96		—
S31f	15	93		4
S32	15	97		2
S34	27	98		1
S34a	4	98		1
S35	23	98		1
S39	7	88		9
S40	11	99		-1
S41a	4	91		5
S41b	3.5	91		7
S43	11	90		—
S43a	3	83		—
S45	10	88		9
S46a	3	83		-
S46b	3	91		4
S46c	2	64		35
S46d	7	96		4
S46e	7	88		—
S46f	6	90		6
S46g	2	90		6
S46h	1.5	66		17
S48u	6	53		46
S48m	1.1	60		40
S48L	9	65		27
S49	2.5	96		2
S49a	12	48		—
S50	12	86		—
S50a	12	94		6
S51	8	98		-1
S52	2	85		15
S55	12	93		—
S55a	3.5	85		—
S57	8	96		3
S58	12	96		3
S58a	9	94		5
S58c	3.5	81		17
S58e	3.5	88		—

in Portland cement concrete (Illinois Div. Highways, 1958, p. 611-621). Possibly another sample might have passed the tests. The sample met the requirements for crushed stone for base and surface courses and class A and B bituminous surfaces.

Warsaw Formation

The Warsaw Formation is mainly shale and contains a few thin interbedded strata of dolomitic and silty limestone. The thickness of the formation is 50 to 87 feet, as determined in wells, but no more than 10 to 15 feet are exposed in the area under study. The upper part of the Warsaw is very similar to the basal beds of of the Salem Formation, and the contact between the two is not always distinguishable. The Warsaw Formation is not considered a likely commercial source of limestone.

Sonora Sandstone

At a few places, a fine-grained, noncalcareous white sandstone, called the Sonora Sandstone, was observed lying beneath dolomitic limestone of the Salem Formation. The full thickness of the sandstone was not observed. The maximum thickness seen was 2.5 feet, but well data suggest a greater thickness than this, possibly reaching 10 feet.

Salem Limestone

The Salem Limestone is variable in character and thickness. At many places, the upper part of the formation consists of fine- to medium-grained, light brown to brown, porous, fossiliferous dolomitic limestone. This limestone occurs in beds usually between 4 and 14 inches thick, however, locally these beds are thinner. The observed total thickness of these beds ranges from 0 to 35 feet. A few geodes were noted. In places, the upper part of the formation is thin bedded, silty, argillaceous dolomitic limestone. In a few places, the topmost Salem beds are sandstone and have a maximum observed thickness of about 5 feet. In other places, particularly in McDonough County, the uppermost 1 to 2 feet are shale or claystone.

The upper part of the Salem Limestone usually grades downward to gray, fine-grained, mostly thin bedded, micaceous dolomitic sandstones and siltstones. The thickness of the lower part is variable and ranges from 10 to 60 feet. The latter figure is taken from well record data, as outcrops do not permit meaningful thickness estimates.

The chemical character of the upper part of the Salem Formation is shown by the analytical data in tables 1 and 2. Sample S 46d (table 1) is a high calcium limestone; the data in table 1 suggest that other deposits may share this characteristic. The tests suggest that the upper part of the Salem is of suitable character at numerous places to be a source of agricultural limestone and possibly of stone for other uses. The high iron oxide content of most of the Salem samples (table 1) is responsible for their buff or brown color.

Physical tests (table 3, S 19a) of a sample of the brown, dolomitic limestone of the Salem show too high a loss in the abrasion test to pass Illinois specifications (Illinois Div. Highways, 1958, p. 611-621) for concrete aggregate; however, the sample did pass specifications of crushed stone for base and surface courses.

TABLE 3 – RESULTS OF PHYSICAL TESTS

Sample Number	Near	Geologic Formation	Abrasion Loss, %*	Sodium Sulfate Soundness	
				Loss, %*	Predominant Failure
M 18	Colmar	Burlington–Keokuk	36	16	Splitting and disintegrating
M 23a	Colmar	St. Louis	32	11	Splitting and flaking
M 23b	Colmar	St. Louis	–	18	Splitting and flaking
S 19a	Brooklyn	Salem	43	15	Flaking
S 19b	Brooklyn	St. Louis	–	31	Disintegrating and crumbling
S 50	Browning	St. Louis	30	9	Splitting and cracking

* State Division of Highway Specifications (Ill. Div. Highways, 1958, p. 611–621):

Coarse aggregate for use in Portland cement concrete and class D, I, and bituminous surfaces:
Abrasion loss limit 35%
Sodium sulfate soundness loss 15%

Coarse aggregate for crushed stone for base and surface courses:
Abrasion loss limit 45%
Sodium sulfate soundness loss 25%

Coarse aggregate for class A and B bituminous surfaces:
Abrasion loss limit 40%
Sodium sulfate soundness loss 20%

Coarse aggregate for waterbound macadam base course:
Abrasion loss limit 40%
Sodium sulfate soundness loss 25%

TABLE 4 – SEQUENCE AND MAJOR CHARACTERISTICS OF LIMESTONES AND ASSOCIATED MATERIALS EXPOSED IN FULTON, MC DONOUGH, AND SCHUYLER COUNTIES

Quaternary System

Pleistocene Series

Loess, silt, clayey

Till, clay, pebbly brown and gray

Pennsylvanian System

McLeansboro Group

Modesto Formation–sandstone, shale, limestone, and coal

Kewanee Group

Carbondale Formation–sandstone, shale, limestone, and coal

Spoon Formation–sandstone, shale, limestone, and coal

McCormick Group

Abbott Formation–sandstone, and coal

Mississippian System

Valmeyeran Series

St. Louis Limestone–limestone, mostly brecciated, locally dolomite and argillaceous

Salem Limestone–limestone, dolomitic grading to silty, argillaceous limestone and siltstone both vertically and laterally. Lower part is mainly dolomitic sandstone and siltstone.

Sonora Sandstone–sandstone

Warsaw Formation–shale and dolomitic siltstone

Burlington–Keokuk Limestones–limestone, coarse grained, fossiliferous, commonly cherty

The variability of the Salem Limestone is a handicap to the production of crushed stone having a constant physical and chemical character.

St. Louis Limestone

The St. Louis Limestone rests on the Salem Limestone, and is overlain by Pennsylvanian age rocks. Where these Pennsylvanian age rocks have been eroded, the St. Louis Limestone is capped by surficial materials. The St. Louis generally is present in the southern half of Fulton County, the southwestern quarter of McDonough County, and the eastern quarter and western third of Schuyler Counties. A small isolated area of St. Louis Limestone without overburden occurs in northwestern McDonough County, near Blandinsville.

The greater part of the exposed St. Louis Limestone is a limestone breccia that consists of angular fragments of limestone, which range from sand size to an observed maximum of about 10 feet. These fragments are set in a variable matrix. The limestone in the breccia is usually light gray in color, fine grained, even textured, and relatively pure. Analyses of sample F 4a in tables 1 and 2 are from the limestone only. Many of the larger blocks of limestone are made up of light gray angular pieces of limestone cemented together by calcite. A few of the limestone pieces in the breccia have slightly rounded edges with a thin rusty coating. As well as the purer limestone pieces in the breccia, there occur, less commonly, fragments of brown, medium-grained dolomitic limestone and chert nodules.

The matrix of the breccia consists of varying amounts of fine-grained calcite, quartz, and clay. Analysis of samples F 4 (table 2) is greatly influenced by the composition of the matrix. In general, the matrix is a relatively soft material and readily weathers away in outcrops. This results locally in small accumulations of limestone gravel. The matrix comprises an estimated 5 to 10 percent of the breccia.

The breccia comprises the lower part of the St. Louis Limestone and varies from about 6 to 20 feet in thickness. In many places, the breccia is overlain by 5 to 10 feet of rusty brown dolomitic limestone in ledges 6 to 12 inches thick.

The St. Louis Limestone has a maximum exposed thickness of about 30 feet in quarries near Colchester, but elsewhere the observed thickness was less.

The chemical composition of the St. Louis Limestone is variable (tables 1 and 2). Some samples are high calcium limestone, others are dolomitic. The amount of silica in the samples ranges from 2.4 to 13.8 percent. Of the 52 samples for which data are given in table 2, 36 samples had a carbonate content of 90 percent or more and 7 samples were in the 85 to 89 percent range. These data indicate that most of the St. Louis Limestone would be a good or at least an acceptable material for agricultural limestone.

Physical tests (table 3) on four samples of St. Louis Limestone show that M 23a and S 50 meet Illinois specifications (Illinois Div. Highways, 1958, p. 611-621), for concrete aggregate and class D, I, and J bituminous surfaces. Sample M 23b meets the soundness specifications of crushed stone for base and surface sources and class A and B bituminous surfaces. Sample S 19b has too high a soundness loss to meet specifications for road stone.

Pennsylvanian Deposits

The deposits of Pennsylvanian age are chiefly shale and sandstone; however, coal and thin limestones occur in some places. One of these limestones, the St.

TABLE 5 — WELL DATA ON SHALLOW LIMESTONES AND DOLOMITES FROM FULTON, MC DONOUGH, AND SCHUYLER COUNTIES

Boring	T.	R.	Sec.	Location	Lithology and Thickness
					FULTON COUNTY
a	5N	3E	4	About 3 mi NNW Lewistown	Unconsolidated cover 15-17 ft., Study of samples indicates the following: 15-20 ft — limestone, dolomitic, buff colored, fine grained 20-26 ft — (no sample) 26-28 ft — limestone, dolomitic, fine grained with some white chert 28-78 ft — (no sample) 78 ft — dolomite — pink and buff, pure 110 ft — dolomite — medium grained plus some pyrite
b	6N	1E	24	Near Seville	Soil 4 ft., gravel, clay, and limestone 6 ft., white clay and limestone 10 ft., limestone 10 ft., shale 10 ft.
c	8N	1E	19	Adjacent to Avon	Clay 15 ft., limestone 10 ft., sandstone 10 ft.
d	8N	4E	11	$SE\frac{1}{4}NE\frac{1}{4}NE\frac{1}{4}$ at Farmington	0-15 ft — soil, fine silt, calcareous 15-20 ft — limestone, fine grained, buff, dense 20-25 ft — same 25-30 ft — same 30-35 ft — shale, black, calcareous
					MC DONOUGH COUNTY
e	5N	4W	2	$NW\frac{1}{4}SW\frac{1}{4}$	Soil 2 ft., limestone 12 ft., limestone (?) and shale 24 ft., limestone 32 ft., shale.
f	5N	4W	32	$NW\frac{1}{4}SW\frac{1}{4}SW\frac{1}{4}$	Soil, silt, and sand 20 ft., limestone, buff colored, fine grained, dolomitic. Some white chert, 10 ft., shale, calcareous with quartz 15+ ft.
g	5N	4W	33	$SW\frac{1}{4}SW\frac{1}{4}$	Silt 18 ft., limestone 30 ft., shale and clay 28 ft., limestone 200 ft.
h	5N	4W	35	$NW\frac{1}{4}SE\frac{1}{4}SW\frac{1}{4}$	Soil, silt, and clay 13 ft., sand and gravel 5 ft., dolomite: calcitic, fine grained, gray, mottled with dark gray, with some chert, quartz grains and traces of clay as impurities, 30 ft.; samples from greater depths are not available, however, drillers log reports this rock type extending an additional 146 feet.
i	4N	4W	2	$NW\frac{1}{4}SW\frac{1}{4}$	Soil 10 ft., lime 196 feet.
j	4N	4W	4	$SW\frac{1}{4}SW\frac{1}{4}$	Soil 5 ft., clay 25 ft., limestone 196 ft.
k	4N	4W	9	$NE\frac{1}{4}NW\frac{1}{4}$	Clay 10 ft., shale 10 ft., limestone 176 ft.
l	4N	4W	18	$SW\frac{1}{4}SE\frac{1}{4}SW\frac{1}{4}$	Soil and silt 20 ft., limestone, dolomitic and cherty 100+ ft.
m	4N	4W	19	$SW\frac{1}{4}NE\frac{1}{4}$	Soil and clay 20 ft., limestone 186 ft.
n	4N	4W	20	$NE\frac{1}{4}NW\frac{1}{4}NW\frac{1}{4}$	Clay 17 ft., limestone, cherty 147 ft.
o	4N	4W	21	$E\frac{1}{2}NW\frac{1}{4}SE\frac{1}{4}$	Clay 18 ft., limestone 192 ft.
p	4N	4W	25	$NW\frac{1}{4}SE\frac{1}{4}$	Soil 20 ft., limestone (?) 70 ft.
q	4N	4W	28	$NW\frac{1}{4}NE\frac{1}{4}NW\frac{1}{4}$	Soil 2 ft., clay 16 ft., limestone, medium and fine grained, dolomitic, cherty and slightly argillaceous in places, 80+ ft.
r	4N	4W	30	$NW\frac{1}{4}SW\frac{1}{4}NW\frac{1}{4}$	Soil 6 ft., limestone 180 ft.
s	4N	3W	30	$SE\frac{1}{4}NE\frac{1}{4}$	Unconsolidated clay, soil, and silt 18 ft., limestone 200 ft.
					SCHUYLER COUNTY
t	3N	4W	2	$SW\frac{1}{4}NE\frac{1}{4}SE\frac{1}{4}$	Clay 29 ft., lime, broken 6 ft., lime, gray-white, cherty 173 ft.
u	3N	4W	3	$S\frac{1}{2}NE\frac{1}{4}SE\frac{1}{4}$	Soil 2 ft., lime 202 ft.
v	3N	4W	16	$SW\frac{1}{4}NE\frac{1}{4}NW\frac{1}{4}$	Clay, sandy 15 ft., lime, broken 23 ft.
w	2N	4W	6	$NE\frac{1}{4}SE\frac{1}{4}SE\frac{1}{4}$	Unconsolidated material 25 ft., lime 395 ft.
x	2N	3W	24	$NW\frac{1}{4}SW\frac{1}{4}SE\frac{1}{4}$	Drift 23 ft., lime 227 ft.
y	3N	1W	19	$NW\frac{1}{4}SW\frac{1}{4}SE\frac{1}{4}$	Soil 8 ft., sand & gravel 16 ft., lime, broken 40 ft., shale 3 ft., lime 30 ft., lime with flint 78 ft., lime, white 203 feet.

David Limestone, has been considered at one time or another as a possible source for crushed stone in western Illinois. Some of the coals are underlain by considerable thicknesses of clay, for example the Colchester (No. 2) Coal. The Pennsylvanian deposits overlie most outcrops of Mississippian limestones.

PLEISTOCENE DEPOSITS

In the area under consideration, there are two principal types of Pleistocene deposits. Loess, the upper deposit, is a clayey silt or silty clay, usually brown in color, which was deposited by wind during ancient dust storms. Till, the lower deposit, is a pebbly clay that was deposited by one of the great glaciers that spread southward over Illinois from Canada many thousands of years ago.

Loess may lie directly on Mississippian or Pennsylvanian rocks or on the till, depending on the amount of erosion of the older rocks. The thickness of till and loess is highly variable, but the maximum thickness estimated at any of the outcrops described in the appendix was 35 feet of till and 25 feet of loess. The full thickness of these materials is believed to be greater than this.

QUARRYING CONSIDERATIONS

Six features characterize the limestone deposits of Fulton, Schuyler, and McDonough Counties: (1) continuous vertical thicknesses of limestone, including dolomitic limestone, are not known to exceed 35 feet; (2) many limestone deposits show considerable vertical and lateral variation in the purity and physical character of the stone; (3) outcrops occur mostly as comparatively low bluffs along streams or in small valleys; (4) the upper surfaces of the limestone deposits are irregular and at many places the amount of irregularity is sufficient to increase the cost of stripping the stone; (5) overburden includes not only till and/or loess, which are generally comparatively easy to remove, but also in many places Pennsylvanian sandstones and/or shales that are likely to be more difficult and costly to strip; (6) large areas under uniformly thin overburden were not observed, and thus, a drilling program would be required for further evaluation. Sites for small- or medium-sized quarries are believed to occur in places of relatively thin overburden. But because of the variable character of the limestone deposits, testing, by drilling or other means, and careful sampling are required to adequately evaluate these deposits.

Advantage may be taken of the brecciated nature of some of the St. Louis strata by modification of some of the quarrying and blasting procedures commonly employed in the winning of stone from well bedded deposits. The chert content is generally low and would not produce excessive wear of crushing equipment.

In the appendix the descriptions of outcrops give information that will be helpful in the search for possible quarry sites.

RESOURCES BY COUNTIES

The limestone resources of each of the three counties covered by this report are described below. Reference will be made to descriptions of outcrops

that are found in the appendix. Outcrops are arranged by county and in numerical order by township and section. The descriptions give information on the overburden, thickness, and character of the limestones. These data are summarized in tables 6, 7, and 8 for the separate counties. The locations of all but a few of the outcrops described are shown on the maps for the three counties (figs. 2-5) Sample numbers correspond to outcrop numbers, for example sample F 1 was taken from outcrop F 1 (fig. 2). But not all outcrops were sampled.

Certain earlier data for Schuyler County (Bleininger et al., 1912, p. 93-100) are included in the appendix, table of chemical analysis (table 1), and figure 4. All are designated by the prefix C. Some of the older outcrop descriptions duplicate, or are near outcrops, examined during the present investigation, and the information given supplements that of the present study. A few of the outcrops could not be found.

Well records in the files of the Illinois State Geological Survey were examined for information on unexposed limestones that might have significance for prospecting. Limestones more than 10 feet thick with less than 30 feet of overburden were examined. Most of the records were drillers logs, but a few samples of well cuttings were available. The well data are summarized in table 5, and locations are shown on figures 3 and 4. A few records, reporting limestones that probably are of Pennsylvanian age, are included.

Fulton County

The Mississippian limestones that crop out in Fulton County are part of the Salem and St. Louis Limestones, largely the latter. The character of these limestones has been described previously. The results of tests are given in tables 1, 2, and 3. Descriptions of the outcrops are given in the appendix and are summarized in table 6. Exposures are limited to bluffs and beds of small streams. Outcrops occur in an area south and southwest of Seville, except for three small areas northeast of Ipava, which are of uncertain extent (fig. 2).

The exposed thickness of limestone is generally small; the maximum thickness about 18 feet is exposed in an idle quarry. Most limestone outcrops have a bedrock shale or sandstone overburden as well as an overburden of surficial clay and/or silt. The total thickness of overburden at some outcrops reaches an estimated 60 feet or more, but at F 8 and F 9, it is less than

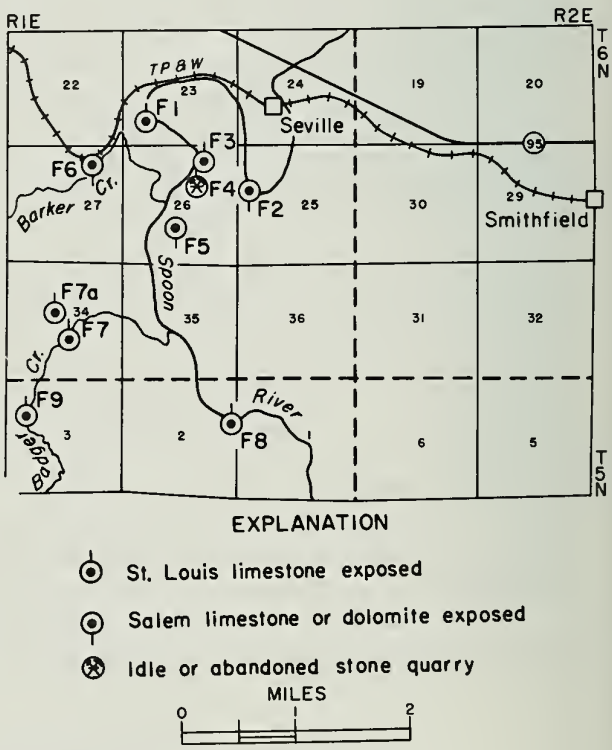

Figure 2 - Locations of outcrops of Mississippian limestones and dolomites in Fulton County.

25 feet. Test drilling is needed to explore fully the overburden condition; some areas, adjacent to outcrops having heavy overburden, may prove to be commercially acceptable.

Only two well records in the Survey files from Fulton County show Mississippian limestones more than 10 feet thick with less than 30 feet of overburden (table 5, boring a and b). Records of two other wells that encountered shallow limestone believed to be of Pennsylvanian age are included in the table also.

TABLE 6 – SUMMARY OF DATA REGARDING OUTCROPS OF LIMESTONE AND DOLOMITE OF MISSISSIPPIAN AGE IN FULTON COUNTY

Outcrop number**	T. R. Sec.	Near	Thickness limestone,* feet	Thickness overburden–feet		
				Covered slope	Surface clays and/or silts‡	Bedrock#
F 1	6N 1E 23	Seville	8 L	50		17
F 2	6N 1E 25	Seville	3 DL	80		18
F 3	6N 1E 26	Seville	10½ L		10	51
F 4	6N 1E 26	Seville	20 L		10	28
F 5	6N 1E 26	Seville	7 D	20		
F 6	6N 1E 27	Seville	6 DL	40		11
F 7	6N 1E 34	Seville	15 L	60		
F 7a	6N 1E 34	Seville	1 L	0	0	0
F 8	5N 1E 2	Seville	5 L	16		
F 9	5N 1E 3	Seville	2 DL	10		10
F10**	5N 2E 22	Ipava	Limestone boulders			
F11**	5N 2E 27	Ipava	Limestone boulders			
F12**	5N 2E 34	Ipava	Limestone boulders			

* L – limestone, D – dolomite, DL – dolomitic limestone

\# Chiefly sandstone and/or clay or shale of Pennsylvanian age

‡ Chiefly loess and glacial till

** Indicates no sample taken

McDonough County

Three limestone units are exposed in McDonough County: (in order of decreasing age) the Burlington-Keokuk, Salem, and St. Louis Limestones. The character of these formations has been described earlier. Results of tests on samples are given in tables 1, 2, and 3. As indicated in figure 3, outcrops of the Burlington-Keokuk Limestones are limited to the southwestern part of the county. Outcrops in the northern and southeastern parts of the area shown in figure 3 are predominantly St. Louis Limestone, but some exposures include both St. Louis and Salem. See appendix and table 7 for detailed description of the outcrops.

The thickness of the exposed limestones, except in operating quarries, ranges from a few feet to a maximum of about 25 feet. Overburden varies from about 5 to 60 feet or more and includes unconsolidated materials, chiefly silt and clay, and in some outcrops, bedrock sandstone and/or shale in addition. The

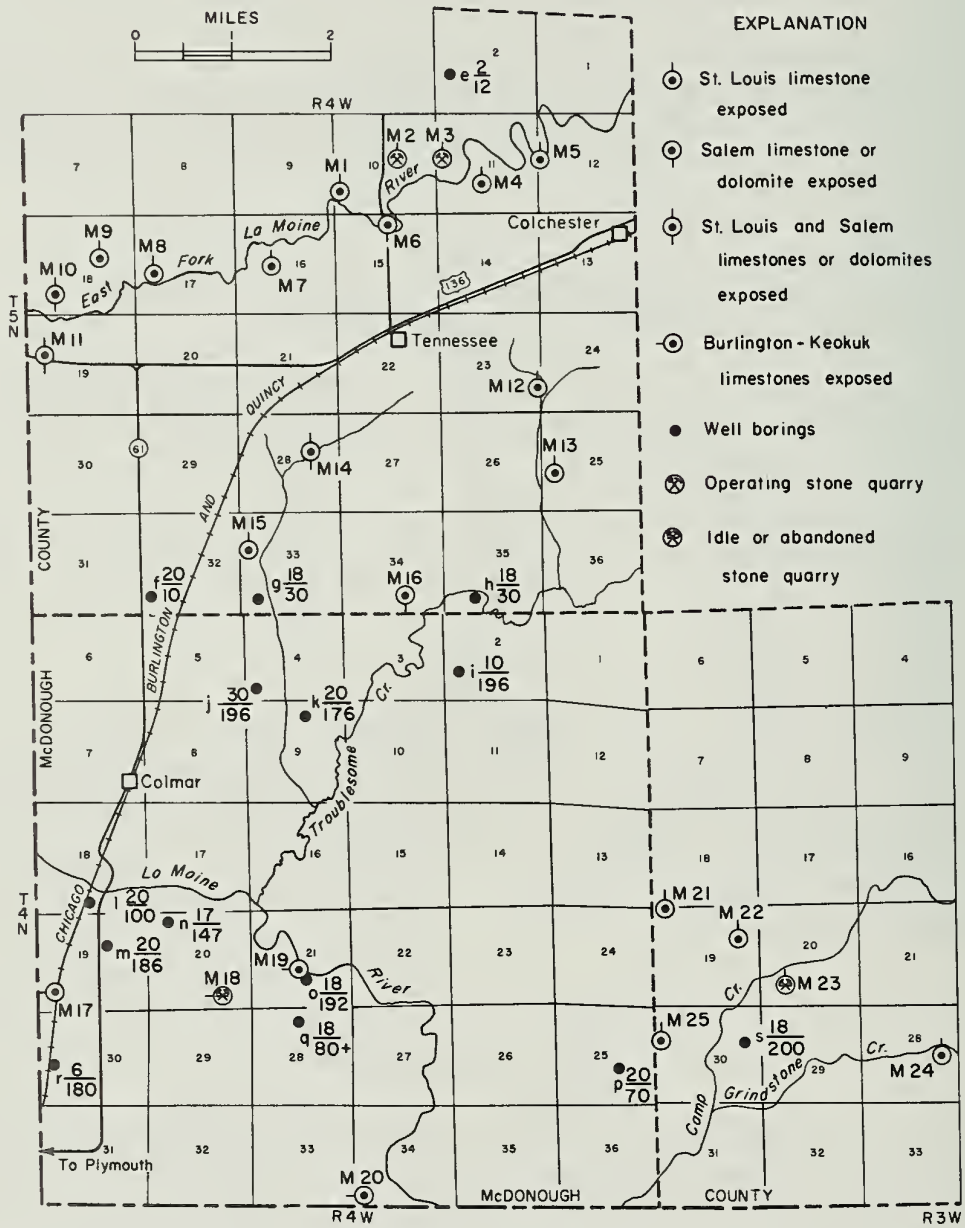

Figure 3 - Locations of outcrops of Mississippian limestones and dolomites and locations of wells (solid dots labeled e-s) in McDonough County. Fraction adjacent to the wells indicates thickness of overburden/thickness of limestone.

character and true thickness of the materials comprising the overburden on most outcrops cannot be determined accurately without test drilling.

In table 5, data are given on well records that report 10 feet or more of limestone with 30 feet or less of overburden (borings e through s). Figure 3 shows the location of the wells and the thickness of overburden and limestone penetrated. The large thicknesses of limestone reported found in the southwestern part of the county indicate the presence of Burlington-Keokuk Limestones.

TABLE 7 - SUMMARY OF DATA REGARDING OUTCROPS OF LIMESTONE AND DOLOMITE OF MISSISSIPPIAN AGE IN MC DONOUGH COUNTY

Outcrop number**	T.	R.	Sec.	Near	Thickness limestone,* feet	Thickness overburden-feet		
						Covered slope	Surface clays and/or silts‡	Bedrock#
M 1	5N	4W	10	Tennessee	25 L	15		24
M 4**	5N	4W	11	Colchester	20 L†		10	3
M 5	5N	4W	12	Colchester	4 DL	75		
M 6	5N	4W	15	Tennessee	4 D	10		
M 7	5N	4W	16	Tennessee	17 L	25		7
M 8**	5N	4W	17	Tennessee	15 L		15	5
M 9	5N	4W	18	Tennessee	25 L†	12		10
M10c	5N	4W	18	Tennessee	10½ L	20		
M10b	5N	4W	18	Tennessee	19½ DL	Lies below M10c		
M11	5N	4W	19	Tennessee	9 L	12		
M12	5N	4W	23	Tennessee	8 L		20	30
M13	5N	4W	25	Tennessee	8 L		15	6
M14	5N	4W	28	Tennessee	8 L	5		
M15	5N	4W	33	Tennessee	25 L	20		3
M16	5N	4W	34	Tennessee	7 DL		30	6
M17	4N	4W	19	Colmar	4 L		5	
M18	4N	4W	20	Colmar	13½ L		5	
M18b	4N	4W	20	Colmar	7 L	Lies below M18		
M19**	4N	4W	21	Colmar	12 L		10	
M20**	4N	4W	34	Colmar	2½ L	10		
M21**	4N	3W	19	Colmar	4 L	20		
M22a	4N	3W	19	Colmar	10 L	20		
M22b	4N	3W	19	Colmar	9 L	Lies below M22a		
M23a	4N	3W	20	Colmar	15 L		15	
M23b	4N	3W	20	Colmar	5 DL	Interbedded with M23a		
M24	4N	3W	28	Colmar	7 L	25		
M25	4N	3W	30	Colmar	13 L	10		
M26	6N	4W	7	Blandinsville	2 L	0	0	0

* L - limestone, D - dolomite, DL - dolomitic limestone

† Outcrop partly covered; thickness inferred

\# Chiefly sandstone and/or clay or shale of Pennsylvanian age

** Indicates no sample taken

‡ Chiefly loess and glacial till

Schuyler County

The Burlington-Keokuk Limestones crop out at three locations in Schuyler County (fig. 4): in the south bank of the La Moine River, at Birmingham (S 5);

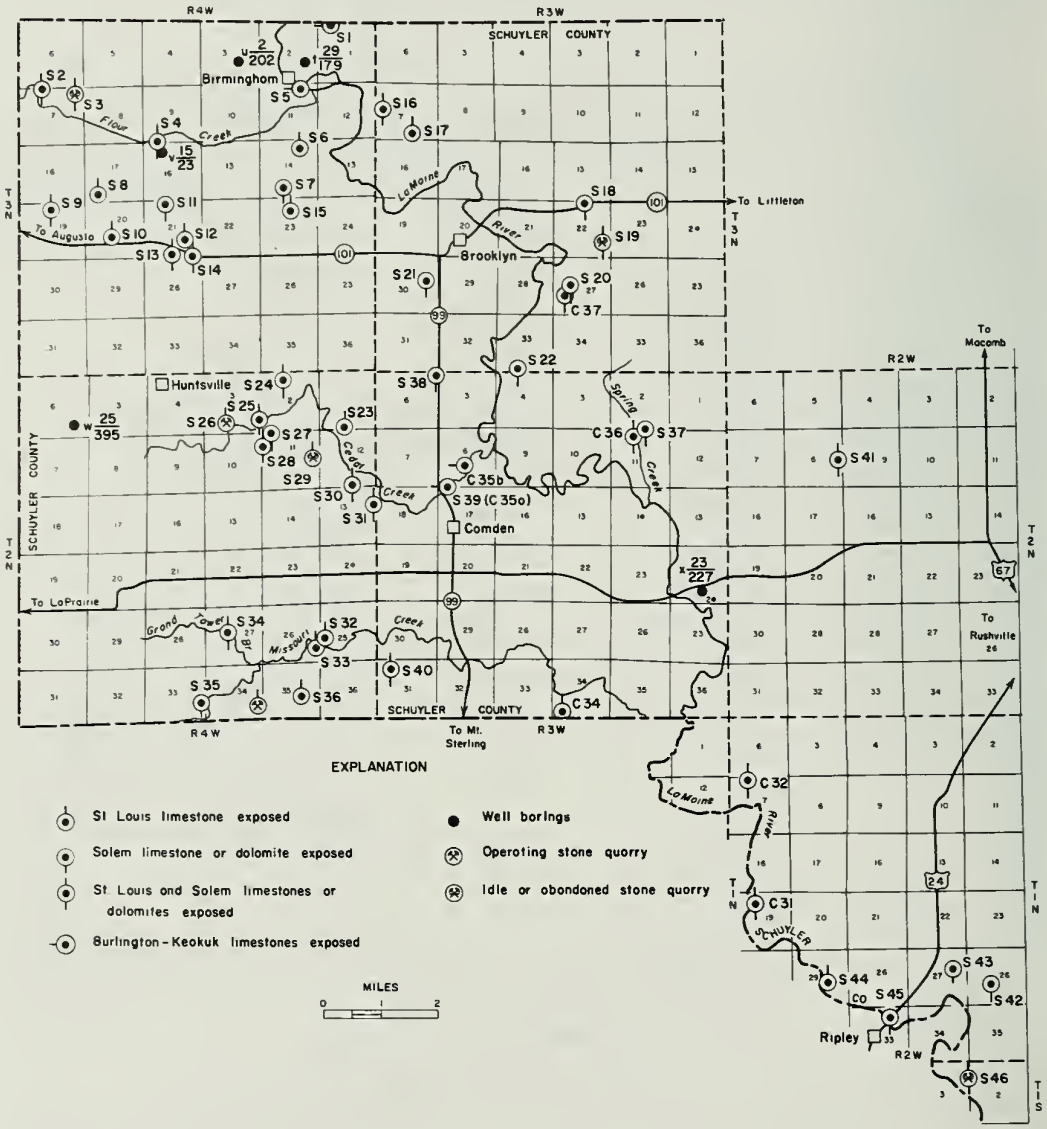

Figure 4 - Locations of outcrops of Mississippian limestones and dolomites and locations of wells (solid dots labeled t-x) in the western part of Schuyler County. Fraction adjacent to the wells indicates thickness of overburden/thickness of limestone.

along a stream tributary to the La Moine, north of Birmingham (S 1); and along Cedar Creek, north of Camden (S 39). A chemical analysis of a sample from outcrop S 39 (sample C 35a) is given in table 1. Brecciated limestone of the St. Louis and dolomitic limestone of the Salem crop out at numerous places along streams and gullies tributary to the Illinois River (fig. 5), along the La Moine River, and in the western third of the county (fig. 4). Results of tests on samples are given in tables 1, 2, and 3. Detailed information of the outcrops is given in the appendix and in table 8. Exposures in the county show thicknesses of limestone or dolomitic limestone up to 35 feet (S 22). The overburden was usually 5-15 feet of Pennsylvanian strata and 30 feet or less of unconsolidated glacial materials. At a few places, deposits of the latter have been, or are being, quarried for sand and gravel. The thicknesses of overburden materials vary considerably throughout the county.

There are six well records available that report 10 feet or more of limestone with less than 30 feet of overburden. The data are listed in table 5 (borings t through y) and the locations and thicknesses are marked on figure 4. Four of the wells are located in the westernmost townships, T. 2 N., R. 4 W., and T. 3 N., R. 4 W. Boring y is located near Rushville. The thick limestone reported in the deeper part of the wells is Burlington-Keokuk.

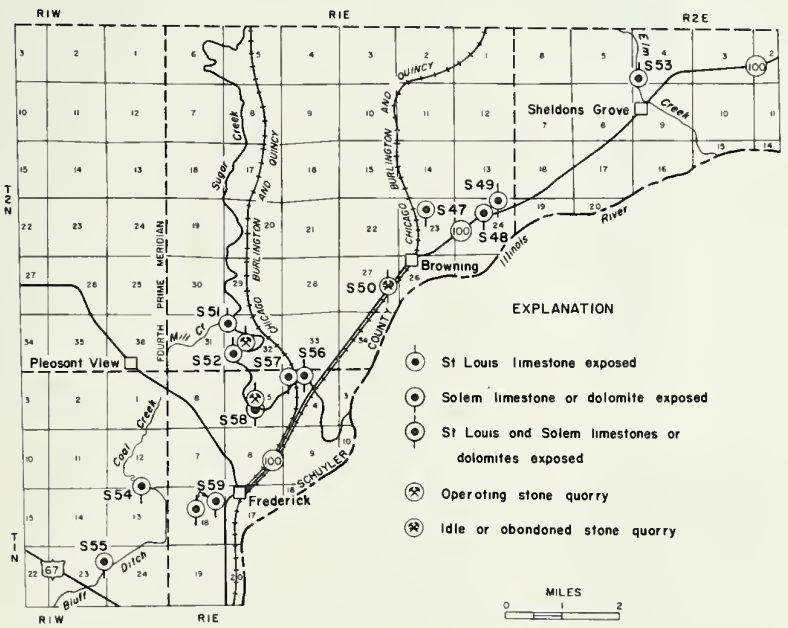

Figure 5 - Locations of outcrops of Mississippian limestones and dolomites in the eastern part of Schuyler County.

TABLE 8 – SUMMARY OF DATA REGARDING OUTCROPS OF LIMESTONE AND DOLOMITE OF MISSISSIPPIAN AGE IN SCHUYLER COUNTY

Outcrop number**	T.	R.	Sec.	Near	Thickness limestone,* feet	Thickness overburden–feet: Covered slope	Surface clays and/or silts‡	Bedrock#
S 1**	3N	4W	1	Birmingham	9½ L		10	
S 2	3N	4W	7	Birmingham	21 DL	20		
S 3**	3N	4W	7	Birmingham	16 L		20	
S 4**	3N	4W	9	Birmingham	16 L		20	
S 5	3N	4W	11	Birmingham	13 L		15	
S 6	3N	4W	14	Birmingham	5½ DL	10		9
S 7	3N	4W	14	Birmingham	5 DL†	20†		
S 8	3N	4W	17	Birmingham	6 L		5	
S 9	3N	4W	19	Birmingham	26½ L and DL[a]		10	10
S10	3N	4W	20	Birmingham	13 L	30		
S11	3N	4W	21	Birmingham	1½ L		12	
S12	3N	4W	21	Birmingham	13 DL	15		
S13	3N	4W	21	Birmingham	20 L	25		6
S14**	3N	4W	21	Birmingham	12 L†	40		
S15	3N	4W	23	Birmingham	7 L	20		4
S16	3N	3W	7	Birmingham	26 L†	25		
S17	3N	3W	7	Birmingham	12 L	25		
S18	3N	3W	22	Brooklyn	4½ D	80		
S19	3N	3W	22	Brooklyn	20 DL	25		
S20**	3N	3W	27	Brooklyn	38 L†[b]	40		20
C37	3N	3W	27	Brooklyn	25 L and D	–	–	–
S21**	3N	3W	30	Brooklyn	2½ DL		3	
S22	3N	3W	33	Brooklyn	35† D†	25		8
S23	2N	4W	1	Huntsville	22 L	30		15
S24	2N	4W	2	Huntsville	26 L and D†[c]	15		3
S25**	2N	4W	2	Huntsville	17 DL		10	
S26	2N	4W	3	Huntsville	20 L	20		10
S27**	2N	4W	11	Huntsville	9½ DL	20		
S28**	2N	4W	11	Huntsville	18 L and D	20		
S29	2N	4W	11	Huntsville	18½ DL		20	
S30**	2N	4W	12	Camden	22 L†	25		
S31	2N	4W	13	Camden	15 L		40	8
S32	2N	4W	25	Camden	15 DL	25		
S33**	2N	4W	26	Camden	15 L	20		10
S34	2N	4W	27	Camden	32 L and D		20	
S35	2N	4W	33	Camden	23 DL	15		
S36**	2N	4W	35	Camden	2L	15		
S37**	2N	3W	2	Camden	18½ DL		20	16½
S38**	2N	3W	6	Camden	2 DL	30		
C35b	2N	3W	8	Camden	12 L	–	–	–
C36	2N	3W	11	Camden	–	–	–	–
S39	2N	3W	17	Camden	7 DL	50	15	3½
S40	2N	3W	31	Camden	21 L and D†		30	
C34	2N	3W	34	Camden	8 L	–	–	–
S41	2N	2W	8	Rushville	5½ L and D		6	
C32	1N	2W	7	Ripley	13 L and D	–	–	–
C31	1N	2W	19	Ripley	5 L	–	–	–
S42**	1N	2W	26	Ripley	2 DL		15	
S43	1N	2W	27	Ripley	14 DL	50		
S44**	1N	2W	29	Ripley	3 L		60	5
S45	1N	2W	33	Ripley	15 D		8	33
S46	1S	2W	3	Ripley	38 L and D†[d]		14	5
S47**	2N	1E	23	Browning	9 DL		25	
S48	2N	1E	24	Browning	20½ DL†	30		1½
S49	2N	1E	24	Browning	12 D	30		14
S50	2N	1E	27	Browning	15 L and D		40	20
S51	2N	1E	32	Frederick	8 D	40		6
S52	2N	1E	32	Frederick	3 L	15		40
S53**	2N	2E	4	Sheldons Grove	7 L	30		
S54**	1N	1W	12	Frederick	15 DL	60		26
S55	1N	1W	23	Frederick	17 DL		35	
S56**	1N	1E	4	Frederick	9 L	6		
S57	1N	1E	4	Frederick	10 L	50		
S58	1N	1E	5	Frederick	15 L†	35		23
S59	1N	1E	18	Frederick	5 DL	40		

* L – limestone, D – dolomite, DL – dolomitic limestone

† Outcrop partly covered; thickness inferred

\# Chiefly sandstone and/or clay or shale of Pennsylvanian age

** Indicates no sample taken

‡ Chiefly loess and glacial till

[a] Includes 6" interbedded shale

[b] May include siltstone

[c] Contains two shale beds

[d] Deposit includes 2 ft. shale bed

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APPENDIX

The outcrops of limestone and dolomite of Mississippian age observed in Fulton, McDonough, and Schuyler Counties are described by county and in numerical order by township and section. The sample numbers correspond to outcrop numbers and the latter are shown on the county maps (figs. 2, 3, 4, and 5).

For brevity the ¼, sec., T., and R. are omitted from the locations given in the appendix, thus (SE SW SE 7, 3N-2E), signifies SE¼ SW¼ SE¼, sec. 7, T. 3 N., R. 2 E.

The succession of strata and geological systems to which the rocks of the three county area belong are shown in table 4. It is noted that the bedrock strata that comprise the overburden on the Mississippian limestones in nearly every case belong to the Abbott Formation of Pennsylvanian age. The unconsolidated overburden of clay or silt is of Pleistocene or Recent age.

In the following description, the overburden on the limestone strata is described from the top of the exposure downward to the limestone. The outcropping limestone is described similarly from the top of the exposed stone downward to the bottom of the outcrop.

DESCRIPTION OF DEPOSITS

FULTON COUNTY (fig. 2)

F1. Southwest bluff, Spoon River, 1 mi. W. Seville (NE SW SW 23, 6N-1E). Overburden: covered slope, 50 ft.; clayey and cherty limestone (Pennsylvanian), 3 ft.; sandstone and shale, 4 ft.; sandstone, 10 ft. Limestone (St. Louis) gray, fine grained, and brecciated, 5-8 ft. (Sample F1).

F2. Southwest bank, Spoon River, near water level (cen. SW NW 25, 6N-1E). Overburden: bouldery clay and Pennsylvanian rocks, 80 ft., over sandstone and shale, 8 ft.; covered, 10 ft. Limestone (Salem) dolomitic, light gray, mottled with tan, fine grained, thin bedded and nodular, 3 ft. (Sample F2).

F3. Steep bluff, E. side Spoon River, 0.8 mi. SW Seville (SE NW NE 26, 6N-1E). Overburden: bouldery clay, 10 ft., over shale (Pennsylvanian), 10 ft.; sandstone, 8 ft.; coal and clay, 1 ft.; shale, 20 ft.; and sandstone, 12 ft. Limestone (St. Louis) light gray, fine grained, brecciated, 10.5 ft. (Sample F3).

F4. Idle quarry of Seville Rock Company, 1.9 mi. S. of Hwy. 95, W. of gravel road (NE SW NE 26, 6N-1E). Overburden: bouldery clay, 5-10 ft., over sandstone (Pennsylvanian), 3 ft.; siltstone, claystone, and coal, 25 ft. Limestone (St. Louis) light gray, brecciated, fine and medium grained, 15-20 ft. beds in lower 5 ft. less brecciated than upper part. Locally, uppermost beds brown, thin bedded, dolomitic limestone, 0-4 ft. Pink calcite, sphalerite, and white kaolinite occur locally in small joints and cavities. Base of quarry is sandy limestone. Sample F4 represents the brecciated units and contains about an average amount of greenish gray matrix material, and F4a is a mixture of limestone fragments and pieces of nonbrecciated limestone that lack the green matrix minerals.

F5. Lower part of small ravines (SE NE SW 26, 6N-1E). Overburden: covered slope, 20 ft., extending up the hill for 10-15 yards, then increases abruptly to 40 ft. or more. Dolomite (Salem) brown, porous, fine-and coarse-grained strata, in beds up to 4 ft. thick, 7 ft. (Sample F5). Underlain by a 4-5 ft. covered interval and sandstone (Sonora), 2.5 ft.

F6. Lower hillsides along tributary to Barker Creek (NE 27, 6N-1E). Overburden: covered slope 30-40 ft., over sandstone (Pennsylvanian), 6 ft.; and covered material, 5 ft. Limestone (Salem) dolomitic, brown mottled with dark gray specks, fine grained and porous, in beds 1-2 ft. thick, 4 ft. (Sample F6). Underlain by Limestone, dolomitic, brown thin-bedded, 2 ft.; sandstone, 1 ft.

F7. Badger Creek bank (SW NW SE 34, 6N-1E). Overburden: covered slope except for massive sandstone (Pennsylvanian), 3 ft. exposed about 15 ft. above the limestone, 40-60 ft. Limestone (St. Louis) light gray and brown, fine grained, siliceous, in jointed beds with greenish gray, silty clay along many joints, 15 ft. (Sample F7).

F7a. Small soiless spot on NE side of hill, SE of Badger Creek (SE SE NW 34, 6N-1E). Limestone (St. Louis) gray, fine grained, massive, 1 ft.

F8. South bank, Spoon River, W. of road (SE SE NE 2, 5N-1E). Overburden: covered slope, 8-16 ft. Limestone (St. Louis) gray, fine grained, brecciated; a few ironstone and chert nodules are also present, 5 ft. (Sample F8).

The limestone also crops out in the road ditch just S. of the bridge and upstream in a small tributary to Spoon River. At the latter outcrop, the limestone is overlain by greenish gray claystone, and upstream by additional sandstone, shale, and coal. The overburden becomes 20-30 ft. a short distance from the river.

F9. Intermittent exposures above and below bridge (NE SW NW 3, 5N-1E). Overburden: covered, locally 8-10 ft.; sandstone and siltstone (Pennsylvanian), 5-10 ft. Limestone (St. Louis) very dolomitic, dark gray and dense, with few chert nodules, 2 ft. (Sample F9).

The following three locations are not shown in figure 2 as they are only small occurrences of limestone boulders, mostly observed in creek bottoms. In no case was a solid ledge observed that might be the parent stratum from which the boulders were derived. Wanless (1957, plate 4) indicates these occurrences as St. Louis Limestone, but the circumstances at F12 suggest that they may be of Pennsylvanian age. The possibility that limestone occurrences would be commercial sources of crushed stone is questionable. Overburden of bedrock and surficial materials is heavy at each location.

F10. Gully W. of road (SE SE SW 22, 5N-2E). Limestone boulders, dark gray, fine grained, jointed, with numerous brown calcite veins. The boulders range in size up to 2 ft. across.

F11. Gully, 0.3 mi. W. of Elrod Bridge (N½ NE 27, 5N-2E). Limestone boulders, as at F10.

F12. Bank of Tater Creek (NE NW SE 34, 5N-2E). Limestone boulders, dark gray, fine grained, jointed with numerous brown calcite and black sphalerite veins up to 1 in. across. The boulders are embedded in a Pennsylvanian (?) deposit of clayey siltstone which is about 6 ft. thick.

F13. A report published in 1870 (Worthen, vol. IV, p. 103, 107) records a 6-10 ft. exposure of St. Louis Limestone above low water level of Spoon River at Bernadotte (19, 5N-2E). The limestone is described as "concretionary" and probably is similar to the brecciated limestones herein described. A careful search of the Bernadotte area failed to disclose the outcrop mentioned.

MC DONOUGH COUNTY (fig. 3)

M1. Intermittent exposure along bluff, N. side East Fork La Moine River (NW SW SW 10, 5N-4W). Overburden: covered slope, 15 ft., over shale and a few thin sandstones (Pennsylvanian), 15 ft.; sandstone, 9 ft. Limestone (St. Louis) light gray, fine grained, brecciated in part; some beds are oolitic and others fossiliferous, the upper 2-3 ft. are thin bedded and dolomitic, 25 ft. (Sample M1).

M4. Ravine and roadcut (SE NE SW 11, 5N-4W). Overburden: clayey silt, 5-10 ft.; over sandstone (Pennsylvanian), 2-3 ft. Limestone (St. Louis) gray, fine grained, brecciated, poorly exposed, 20 ft.

M5. Banks of stream (SW SW NW 12, 5N-4W). Overburden: covered slopes on both sides of the stream, 50-75 ft. Limestone (St. Louis) dolomitic, medium grained, 4 in. beds, 4 ft. (Sample M5).

M6. Northeast end of bridge (NW NW NE 15, 5N-4W). Overburden: covered, few geodes present in the soil, 7-10 ft. Dolomite (Salem) siliceous, light buff and gray, fine grained, dull, in massive beds, 4 ft. (Sample M6).

M7. Bluff, E. side gully (N½ NE SW 16, 5N-4W). Overburden: covered slope, 15-25 ft.; sandstone, 7 ft. Limestone (St. Louis) light gray, mostly fine grained, jointed and brecciated, 17 ft. (Sample M7). Claystone (Salem) bluish gray, 3 ft.; sandstone, calcareous, 4 ft.

M8. Hillside, along wagon trail (NE NW SW 17, 5N-4W). Overburden: gentle slope on bouldery silt and sand, 10-15 ft., over sandstone (Pennsylvanian), 2-5 ft. Limestone (St. Louis) gray and light gray, mostly fine grained, highly brecciated with greenish gray, sandy matrix near base as well as some chert and green clay, 8 ft. Underlain by sandstone, greenish gray mottled with brown which is interbedded with thin siltstone and shale, 12-15 ft.

M9. Poor exposure in gully, N. of road (SE SW NE 18, 5N-4W). Overburden: covered, 10-12 ft., over shale and siltstone (Pennsylvanian), 5 ft.; massive sandstone, 5 ft. Limestone (St. Louis) jointed and brecciated, mostly covered, 20-30 (?) ft. (Sample M9).

M10. Gully, ¼ mi. E. county line, N. side East Fork La Moine River (NE SW SW 18, 5N-4W). Overburden: covered, gentle slope for 20 ft. Blocks of sandstone (Pennsylvanian) observed in soil. Limestone (St. Louis) gray, fine grained, brecciated, in wavy beds 3-5 in. thick near base, 10.5 ft. (Sample M10c). Limestone (Salem) dolomitic, brown, medium and fine grained, slightly porous, some calcite and quartz present, very thick bedded; the lower 9.5 ft. are intermittently covered, 18.5 ft. (Sample M10b). Siltstone, greenish gray and dark gray shales, 7 ft.

Dolomitic limestones of the Salem Formation appear to be considerably thinner in nearby gullies.

M11. Roadcut, N. side of Hwy. 136, 0.5 mi. E. bridge (SW SW NW 19, 5N-4W). Overburden: covered, 10-12 ft. Limestone (St. Louis) gray, mottled brown and somewhat sandy near top, brecciated, irregular bedding up to 8 in., 9 ft. (Sample M11); covered, 5-10 ft. In bank of stream, S. of road: Limestone (Salem) buff, coarse grained, in beds 1-5 in. thick, 5 ft.; gray shale, 12 ft., base covered by stream.

M12. Small bluffs along W. fork of a tributary to Troublesome Creek (SE NE SE 23, 5N-4W). Overburden: clayey silt, 10-20 ft.; shale and sandstone (Pennsylvanian) in beds 2-4 in. thick, 20-30 ft. Limestone (St. Louis) light brown, medium grained, in beds up to 10 in. thick, 2 ft. Limestone gray, jointed and brecciated with notable green silt and clay and nodules of chert, 6 ft., base covered (Sample M12).

M13. Poor exposure in branch, W. of road (cen. NW SW 25, 5N-4W). Overburden: bouldery clay and silt, 15 ft., over sandstone and shale (Pennsylvanian), 4-6 ft. Limestone (St. Louis) gray, brecciated, partly covered, 8 ft., base covered (Sample M13).

M14. Prospect pit north side of creek, and in creek bed (NE SW NE 28, 5N-4W). Overburden: covered, 5 ft. Limestone (St. Louis) gray and brownish gray, fine grained, highly jointed and brecciated; the matrix is conspicuous and consists of greenish gray clayey silt, 8 ft. (Sample M14); covered, 3-4 ft. Limestone (Salem) brownish gray, fine grained, dull, 4-7 in. beds, 2.5 ft.

The overburden gradually increases to about 25 ft. several yards up the hill and additional limestone and/or Pennsylvanian strata may be present. Downstream a short distance a thin bedded siltstone and calcareous sandstone can be seen to underlie the Salem Limestone.

M15. Intermittently exposed in gully on W. side of tributary stream about 0.1 mi. E. of gravel road (NW SW NW 33, 5N-4W). Overburden: covered, 3-5 ft., increasing to about 20 ft. some distance up the slope toward the road. South of M15, 0.3 mi., there are 2-3 ft. of silty shale (Pennsylvanian) visible in the roadcut. Limestone (St. Louis) gray, highly jointed, nodular, bedding very irregular, 25 ft., (Sample M15). Claystone (Salem) greenish gray, 1-2 ft.

M16. West bank of stream (NE SW SE 34, 5N-4W). Overburden: bouldery clay and silt, 20-30 ft., over shale, 3 ft.; sandstone, 3 ft. Limestone (Salem) dolomitic and silty, bluish gray with some buff zones, fine grained, dull, and soft; in beds 2-8 in. thick, weathers into thin slabs, 7 ft. (Sample M16).

M17. Bank along newer of two Chicago, Burlington and Quincy Railroad tracks (NW SW SW 19, 4N-4W). Overburden: clayey silt, 5 ft. Limestone (Burlington-Keokuk) light gray, mottled dark gray,

medium- and coarse-grained beds 3–4 in. thick, scattered chert nodules, 4 ft. (Sample M17).

This limestone is very similar to the upper few beds exposed in the R. & L. O'Neal and Sons Quarry, located 0.5 mi. to the W. in Hancock County.

M18. Abandoned quarry, adjacent to gravel road, 1.5 mi. N. of Plymouth–Industry road (NE SW SE 20, 4N–4W). Overburden: mainly silt up to 5 ft. Limestone (Burlington–Keokuk) light buff, medium- and coarse-grained particles densely packed in fine-grained matrix, relatively thin bedded, with widely scattered chert nodules near base, 5 ft.; limestone, as above, but generally in 10–12 in. beds, 4.5 ft.; limestone, as above but in irregular beds ½–10 in. thick, and interbedded with several clayey beds, 3 in. thick, scattered chert nodules also present, 4 ft. Covered–talus slope, probably limestone as above because this zone was extensively quarried, 5 ft.; limestone, buff, thin bedded, clayey, contains some chert, 7 ft. (Sample M18b).

The lower limestone unit has not been as extensively quarried as the overlying units and it forms the floor of much of the quarry. Sample M18 represents the accessible units that were extensively quarried.

M19. Under road bridge on S. side of La Moine River (cen. 21, 4N–4W). Overburden: clayey silt, partly covered, 5–10 ft. Limestone (Burlington–Keokuk) light gray, mottled tan, coarse grained with fossil particles packed in fine-grained matrix, 1–10 in. beds; contains irregular lenses of light gray chert, ½–3 in. thick, 7 ft.; limestone, clayey, 2.5 ft.; limestone, light gray, coarse grained, massive, 2.5 ft., base covered by river alluvium.

M20. Small ravine (SW SW SW 34, 4N–4W), and in a small knoll (NW SW SW 34, 4N–4W). Overburden: covered, 5–10 ft. Limestone (Burlington–Keokuk) gray and cherty, 2.6 ft., base covered.

M21. Poor exposure along ravine (NW NW NW 19, 4N–3W). Overburden: covered, 5–20 ft. Limestone (St. Louis) gray, jointed and brecciated, 4 ft.; sandstone (Salem) 3 ft., base covered.

M22. Banks and stream beds and in tributary to a larger north–south tributary to Camp Creek (NW SE NE 19, 4N–3W). Overburden: covered possibly some limestone in lower part, 5–20 ft. Limestone (St. Louis) gray, mottled dark gray in upper part, jointed and brecciated, in irregular beds, with greenish gray clayey matrix, 10 ft. (Sample M22a). Shale, gray, silty and calcareous, variable in thickness, 0–10 ft. Limestone, brecciated in upper 2.5 ft., greenish gray clayey partings in the lower 2/3 of bed, 9 ft. (Sample M22b). Sandstone (Salem) calcareous and micaceous, in massive cross bedded strata, 4 ft.

M23. Quarry, formerly operated by the Olson Bros., N. of gravel road (NE SW SW 20, 4N–3W). Overburden: covered, mainly silt, 2–15 ft. Limestone (St. Louis) dolomitic, grayish brown, thin bedded, discontinuous, 0–6 ft.; limestone, light gray, fine and medium grained, and dull; in discontinuous brecciated and jointed beds (Sample M23a). Two massive beds, or large blocks of brown dolomitic limestone with a total thickness of about 3 ft. occur interbedded with the gray limestone, however, they are not continuous throughout the pit. Sample M23b represents these beds. The limestone at this quarry varies from 15–20 ft. in thickness.

M24. Poor exposure in the NE end of knoll (NW NE SE 28, 4N–3W). Overburden: covered, many blocks of massive sandstone occur on hillside indicating Pennsylvanian sandstones probably present, 10–25 ft. Limestone (St. Louis) gray, brecciated, 7 ft., base covered (Sample M24).

M25. Roadcut and hillsides to the E. and W. of the road (NW SW NW 30, 4N–3W). Overburden: covered slope to farm house and adjacent buildings to the E., 0–10 ft. Limestone (St. Louis) gray and light gray, fine grained and brecciated, 12–13 ft. (Sample M25). Sandstone (Salem) brown and fine grained interbedded with shale, 3 ft., base covered.

M26. Small knoll in bed of Baptist Creek, 2 mi. S. of Hwy. 9 and 400 yards E. of county line road (NE NW NW 7, 6N–4W). Not shown on McDonough County Map (fig. 3). Limestone (St. Louis) gray, fine grained, glistening and dense, with few chert nodules; in finely laminated, jointed, and distorted 4–10 in. beds, 2 ft. (Sample M26).

SCHUYLER COUNTY (fig. 4, 5)

S1. Stream cut, NW end of bridge (NE NW NW 1, 3N–4W). Overburden: mainly silt, 10 ft. Limestone (Burlington–Keokuk) gray, coarse-grained fossil fragments set in tan, fine-grained matrix, small lenticular chert masses present along bedding planes, 9.5 ft., base covered by stream.

S2. Gully, NW side Flour Creek (NW NE NW 7, 3N–4W). Overburden: covered steep slope, some blocks of sandstone (Pennsylvanian) observed in soil, 20 ft. Limestone (St. Louis) dolomitic, gray, fine grained, brecciated with some greenish clay and silt, 21 ft. (Sample S2b).

Limestone (Salem) dolomitic, brown, mottled greenish gray, coarse-grained particles in fine-grained matrix, mostly thin bedded in upper 2 ft., fossiliferous with green clay partings and a few geodes in the underlying 4 ft., and brown colored, medium-grained, porous, massive beds in lower 3 ft., total: 9 ft. (Sample S2a).

S3. Abandoned quarry 0.1 mi. S. of road (NE NE 7, 3N–4W). Overburden: silt, pebbly clay and soil, 12–20 ft. Limestone (St. Louis) light gray, fine grained, jointed and brecciated; the character of the stone is highly variable and is notably clayey on the W. side of the pit, 15 ft. Limestone (Salem) dolomitic, impure, 1 ft., exposed.

The St. Louis Limestone was quarried and several square ft. of the upper surface of the stone have been stripped of overburden on the N. side of the pit. Much limestone exists to the E. and W. of the pit. This stratum was not sampled but a sample was taken ½ mi. to the W. (Sample S2b).

S4. Bluff along small stream tributary to Flour Creek on W. side of road near S. line of section (SW SE SW 9, 3N–4W). Overburden: mainly silt, up to 20 ft. over a sandstone (Pennsylvanian) that is nearly white, 22 ft. Limestone (St. Louis) gray, fine grained, brecciated in part and poorly exposed, 16 ft.

The underlying strata are exposed about 0.1 mi. N. in a bluff containing about 10–15 ft. of silt overlying the following section: Limestone (Salem) dolomitic, fine grained in beds 12–15 in. thick, interbedded with thin micaceous and sandy limestone, 4–5 ft.; limestone, dolomitic, conglomer-

atic at top and grades downward to fine grained, 3–4 ft.; shale, 4 ft.; claystone, 2 ft.

S5. South bank of LaMoine River, 100 yards E. of bridge (NE NW NE 11, 3N–4W). Overburden: mostly silt, 10–15 ft. Limestone (Burlington–Keokuk) light gray, mostly medium grained, in thin beds separated by clayey and lenticular chert masses, 13 ft., base covered by river (Sample S5).

S6. Falls in stream bed (SE NW NE 14, 3N–4W). Overburden: mainly silt, 1–10 ft. over Pennsylvanian buff, quartzose, sandstone, 6–9 ft. Limestone (St. Louis) dolomitic, light gray, fine grained, brecciated with notable clay and silt along joints, 5.5 ft. (Sample S6). Siltstone (Salem), interbedded with sandstone, 3 ft.

S7. Ravine, W. of road (NE SE SW 14, 3N–4W). Overburden: covered slope, 20 ft. Limestone (Salem) dolomitic, slightly sandy, buff gray, fine grained, irregular bedding, 5 ft. (Sample S7). One eighth mi. SE of S7, near top of hill, 2 ft. of dolomitic limestone is exposed.

S8. Gully, W. side near top of hill (SE SW SW 17, 3N–4W). Overburden: locally only silt, 5 ft.; other nearby places as much as 12 ft. of sandstone (Pennsylvanian). Limestone (St. Louis) buff, fine grained, jointed and nodular, 6 ft. (Sample S8).

S9. Bluff along creek (Cen NE NW 19, 3N–4W). Overburden: silt and soil, 10 ft., over micaceous sandstone (Pennsylvanian), 4 ft.; shale, 6 ft. Limestone (St. Louis) light gray, fine grained and brecciated, 12 ft. (Sample S9). Limestone (Salem) dolomitic, brown, 10 ft.; clayey in a 2 ft. zone located 5 ft. above base of unit. Shale, 0.6 ft.; limestone, dolomitic, brown, porous with fossils and geodes, 4 ft., over shale, 1 ft. (Sample S9a taken from the dolomitic limestone beds only).

S10. Gully, S. side (NE NE SW 20, 3N–4W). Overburden: mainly silt with several blocks of sandstone (Pennsylvanian) in the top soil, 20–30 ft. Limestone (St. Louis) siliceous and dolomitic, gray, medium grained, nodular and brecciated, somewhat clayey and nonbrecciated in lower 2 ft. of exposure, 13 ft. (Sample S10).

S11. Bank and bed of stream (NW NE NW 21, 3N–4W). Overburden: mainly silt, 7–12 ft. Limestone (Salem) clayey and sandy, dark gray, fine grained, thin bedded, 1.5 ft. (Sample S11).

S12. Creek bed near road turn, ¼ mi. N. of Hwy. 101 (SE NW SE 21, 3N–4W). Overburden: covered slope, 15 ft., few sandstone blocks in the soil. Limestone (St. Louis) dolomitic, light gray, fine grained, jointed, in beds 2–8 in. thick, interbedded with thin dolomitic limestone strata; lowermost beds sublithographic and nodular, 13 ft. (Sample S12).

S13. Stream bank, W of road (SE SE SW 21, 3N–4W). Overburden: covered slope, 20–25 ft., over sandstone (Pennsylvanian), 6 ft. Limestone (St. Louis) light gray, fine grained, dull, jointed and brecciated with some clay along joints, 12–14 ft. (Sample S13b). Limestone (Salem) dolomitic and siliceous, fine grained, thin bedded in upper 2 ft. dark brown, porous, thick bedded in lower part, 5–6 ft. (Sample S13a). Shale, dolomitic, interbedded with sandstone, 2 ft.

S14. Creek bank near culvert S. side of Hwy. 101 (SW SE SE 21, 3N–4W). Overburden: covered steep slope, 30–40 ft. Limestone (St. Louis) fine grained, brecciated, poorly exposed, 9–10 ft., over limestone (Salem) dolomitic, sandy and micaceous, 2 ft.

S15. Small gully at natural spring (SW NW NE 23, 3N–4W). Overburden: covered gentle slope, 20 ft., over sandstone (Pennsylvanian), 4 ft. Limestone (St. Louis) gray, fine grained, jointed and brecciated in lower part, 7 ft. (Sample S15).

S16. Small bluff in gully (SW SW NW 7, 3N–3W). Overburden: mostly covered, several large glacial boulders and blocks of sandstone (Pennsylvanian) occur in soil, 20–25 ft. Limestone (St. Louis) light gray, in beds 6–8 in. thick, 2–3 ft.; limestone, clayey, jointed and brecciated; in lower 9 ft. the stone contains notable quartz grains and is more thick bedded and partly covered, 14–16 ft. (Sample S16). Limestone (Salem) dolomitic, sandy, brown, and fossiliferous, 1.5 ft.

S17. Bluff on E. Side of small stream (SW SW SE 7, 3N–3W). Overburden: gently sloping pasture land, sandstone pebbles in soil suggest the presence of sandstone bedrock, 20–25 ft. Limestone (St. Louis) light gray and buff, brecciated and highly jointed with a notably clayey and silty matrix; locally thin bedded dolomite at top, and massive with worm-like texture near middle; lower strata mainly gray and medium-grained limestone. Near southern end of exposure are gray limestone ledges in wavy, 3–4 in. beds, 12 ft. (Sample S17).

S18. South bank of stream, 1/8 mi. N. Hwy. 101 (NW NW NE 22, 3N–3W). Overburden: covered steep slope, 70–80 ft. Dolomite (Salem) brown and mottled gray, fine and medium grained, porous, and fossiliferous, in beds up to 8 in. thick, 4.5 ft (Sample S18).

S19. Idle quarry E. of road and 3/4 mi. S. Hwy. 101 (S½ NE SE 22, 3N–3W). Overburden: mostly silt in upper part, covered in lower part, 25–30 ft., over shale and siltstone (Pennsylvanian), 5.5 ft. Limestone (St. Louis) light gray, fine and medium grained, mostly thinly laminated; locally jointed near base, 0–7 ft. This limestone unit appears only in the eastern part of the quarry (Sample S19b). Limestone (Salem) dolomitic, brown, fine and medium grained, slightly porous, very uniform in color and texture, in beds 1.5–2.0 ft. thick; upper 3 ft. are weathered and has a sandy "feel," 18–20 ft. (Sample S19a). Underlain by dark gray and brown limestone that forms the floor of the quarry.

S20. Steep bluff on SW side of creek (SW SE NW 27, 3N–3W). Overburden: mainly silt forming steep slope, 20–40 ft., over sandstone (Pennsylvanian), 10 ft.; the underlying material is covered for 10 ft. Limestone (Salem) light gray, fine grained and dull, irregularly bedded, 14 ft. The underlying 10 ft. is covered and is succeeded by limestone, gray, very clayey and silty, 10–14 ft.; siltstone and shale, 6 ft.; limestone, greenish gray, coarse grained, fossiliferous, glistening, and thin bedded, 3 ft.

C37. Ravine, near top on E. side of La Moine River (SW 27, 3N–3W). Overburden: unknown (see S20). Limestone (St. Louis) siliceous, broken into small sharp fragments, 8–10 ft. (Sample C37). Dolomite (Salem) irregularly bedded, very uneven, shattered and siliceous shale, 15 ft.; limestone, clayey, geodiferous, 4 ft.

S21. Small bluff on NW side of small creek (SW SE NE 30, 3N–3W). Overburden: mainly silt, 3 ft. Limestone (Salem) dolomitic, brown, fine grained,

very dull and thin bedded, soft and weathered, 2.5 ft.; shale, 1 ft.

S22. Bed of small stream tributary to La Moine River (S½ SE SW 33, 3N-3W). Overburden: steep, heavily forested slopes rising to agricultural fields, 20-25 ft., over massive quartzose sandstone (Pennsylvanian), 4-8 ft. Dolomite (Salem) brown, fine grained and dull, in thin sandy beds, partly covered, 0-7 ft.; dolomite, brown, fine grained, very porous, 3 ft. beds, partly covered near the top, lower part mottled brown in beds 4-8 in. thick, 35 ft. (Sample S22). Underlying the dolomite is a covered interval 4.5 ft. thick, over shale, 4 ft.; sandstone, 0.7 ft.

S23. Old roadcut and adjacent hillsides (SE SE SW 1, 2N-4W). Overburden: mainly silt, partly covered, 0-30 ft., over sandstone (Pennsylvanian), locally shaly, 8-15 ft. Limestone (St. Louis) dolomitic, brown, thin bedded, dull, 0-2 ft. (Sample S23). Limestone, light gray, fine grained with numerous calcite veinlets; upper surface very irregular, 18-20 ft. (Sample S23a).

S24. Stream bed in small gully, 1/8 mi. N. of road (Cen. NE NW 2, 2N-4W). Overburden: covered, 10-15 ft., over sandstone (Pennsylvanian), 2-3 ft. Limestone (St. Louis) siliceous, gray, fine grained, dense, glistening; contains small patches of tan colored and coarse grained calcite; in wavy beds with green clay on bedding planes, highly jointed, 4 ft. (Sample S24c). Shale with limestone pebbles, 2-3 ft.; limestone, nodular in part, fine grained, buff gray, with kaolinite veinlets, 1.5 ft. (Sample S24b); covered 1.5 ft. Dolomite (Salem) grayish buff, fine grained, massive, 0.5 ft.; shale, 0.5 ft.; dolomite, brown, partly brecciated, in beds ½-7 in. thick, mostly fine grained and massive, lower part porous, 15 ft. (Sample S24a). Underlain by grayish shale, 5 ft.

S25. Cuts on both sides of road dividing secs. 2 and 3 just N. of Cedar Creek (NW SW SW 2, 2N-4W). Overburden: mainly silt, partly covered, 5-10 ft. Limestone (St. Louis) dolomitic, light brown, fine grained, medium bedded, and weathered, 3-4 ft.; limestone, dolomitic, brown, mottled with dark specks, fine grained and even textured in thin beds, 2-3 ft.; limestone, gray and light gray, fine and medium grained in beds up to 4.5 ft. thick and brecciated in part, 6-8 ft. Limestone (Salem) dolomitic, brown, fine grained, partly covered, 2 ft.

The amount of material overlying the St. Louis Limestone in the hills to the E. and W. of the road increases fairly steeply to about 30 ft., and many tall trees occur on the hill slopes.

S26. Idle quarry on N. side of Cedar Creek (Cen. SE SW 3, 2N-4W). Overburden: mostly covered, silt visible locally, 10-20 ft., over massive and buff colored sandstone and shale (Pennsylvanian), 4-10 ft. Limestone (St. Louis) light gray, weathers brown, fine grained, conchoidal fracture, brecciated in part and very irregularly bedded, 11 ft.; limestone, sandy, coarse grained, and discontinuous beds, 0-2 ft.; limestone, gray, fine grained, irregular beds, 3 ft.; limestone, siliceous, gray and light gray, fine grained, in irregular 4-16 in. beds, 4 ft. (Sample S26 is from 17 ft. of limestone described above).

S27. Roadcut along N. boundary of section (NW NW NW 11, 2N-4W). Overburden: mostly covered, silt visible locally, 20 ft. Limestone (Salem) dolomitic, brown, mostly thin bedded and partly covered, 9.5 ft.

S28. Roadcut along W. boundary of section (SW NW NW 11, 2N-4W). Overburden: covered, several blocks of Pennsylvanian sandstone occur as float, 20-40 ft. Limestone (St. Louis) gray, fine grained, and jointed, 3 ft. Dolomite (Salem) brown, in massive beds, 12-15 ft. (See Sample S24a for results of tests on these strata from a nearby locality).

S29. Abandoned quarry N. side tributary to Cedar Creek (SE SE NE 11, 2N-4W). Overburden: silt, partly covered, 20 ft. Limestone (St. Louis) dolomitic, brown and light gray, mostly dull, fine grained with elongated areas of coarsely crystalline calcite (worm-like texture), partly covered near base, 4.5 ft.; limestone, dolomitic, brownish gray, fine grained and mostly jointed, covered in lower 2 ft., 11.5 ft.; limestone, dolomitic (95% carbonates), brown and fine grained; exposed in stream bed below floor of quarry, 2.5 ft.; covered, 5 ft.; limestone, clayey, greenish gray, fine grained and thin bedded, 1 ft. The upper 14 ft. of limestone was quarried (Sample S29).

S30. Beginning near southern boundary of section and extending down the prominent gully along old road to the S. bank of Cedar Creek (SW SE 12, 2N-4W). Overburden: covered, sandstone (Pennsylvanian) float blocks up to 2 ft. across occur about 10 ft. below top of hill, 10-25 ft. Limestone (St. Louis) gray, medium grained, interbedded with light buff and massive calcareous sandstone, 3-4 ft.; limestone, gray, medium grained, brecciated, consists partly oolitic limestone and a few sandstone fragments, 6 ft.; covered, 3-5 ft.

Limestone (Salem) dolomitic, brown, mottled with numerous black specks, dense, hard, in 2 beds, 3 ft.; covered, probably thin bedded dolomitic limestone, 4 ft.; limestone, gray, medium grained, dense, and glistening, in 2-3 in. beds, 1 ft.; covered below for 20-30 ft. Limestone, gray, mottled green and brown, medium grained, fossiliferous (bryozoan) and massive, grades laterally into thin bedded dolomitic limestone with numerous green shaly partings, 6.5 ft.; limestone, silty, dolomitic, thin bedded, grades downward to gray mottled with brown, fine grained, porous (bryozoan molds) in 2-6 in. beds, 8 ft.; limestone, dolomitic, brown, with gray bands and dark specks, some fossil molds, in beds up to 1.3 ft. thick, but varies laterally to thin beds, 3.7 ft.; siltstone, gray, thin bedded, 1.6 ft.; limestone, dolomitic, gray with brown streaks, in beds 1-8 in. thick, grades laterally into calcareous siltstone, 3 ft.

S31. Gully, 1/8 to ¼ mi. N. of road (NE SE NE 13, 2N-4W). Overburden: mainly silt, partly covered, 10-40 ft., over massive and medium-grained sandstone (Pennsylvanian), 4-8 ft. Limestone (St. Louis) light gray, fine grained, nodular and brecciated, 15 ft. (Sample S31f). Sandstone (Salem) fine grained, light gray, massive, 5 ft.; limestone, dull, nodular and brecciated (98% acid soluble), 4 ft.; covered, 3.5 ft.; limestone, brown, with few scattered coarse-grained calcite particles (93% acid soluble, 2 ft.; covered, 16.5 ft.; limestone, dolomitic, brown, fine grained and porous (89% acid soluble), 1.5 ft.; covered, 4.5 ft.; limestone, clayey, greenish gray, coarse grained (83% acid soluble), 1 ft.

S32. Bluff on E. side of road (NW NW SW 25, 2N-4W). Overburden: covered, silt visible locally and much sandstone float present, 15-25 ft. Limestone (St. Louis) dolomitic, gray, fine grained, jointed and brecciated, glistening sublithographic

fragments in the upper part of the unit, grading to dull in the lower part, 15 ft. (Sample S32).

S33. Roadcut W. side (NE SE SE 26, 2N-4W). Overburden: covered, 10-20 ft., over shale and possibly sandstone (Pennsylvanian), partly covered, 10 ft. Limestone (St. Louis) dolomitic, gray, fine grained, jointed and brecciated, 15 ft., base covered. See analyses of these strata from S32.

S34. Southwest bank of Grand Tower Branch, 1/8 mi. W. of dirt road (SE SE NW 27, 2N-4W). Overburden: gentle slope, glacial drift, visible locally, 5-20 ft. Limestone (St. Louis) brown, fine grained, dull, and thin bedded, 1 ft.; limestone, fine grained, brecciated and jointed with some clay matrix, partly covered, 27 ft. (Sample S34). Dolomite (Salem) brown, fine grained dense in massive beds 8-18 in. thick, 4 ft. (Sample S34a).

S35. West bank of Missouri Creek and up gully (E½ NE SE 33, 2N-4W). Overburden: covered gentle slope, 10-15 ft. Limestone (Salem) very dolomitic, brown, mottled gray, fine grained, moderately porous in beds 10-15 in. thick, some beds are covered particularly in the upper 6 ft. of the outcrop, 23 ft. (Sample S35).

The hillside above the Salem slopes gently upward for several hundred yards to approximately 10-15 ft. above the limestone. An earth dam extends across the gully near its head and creates a pond.

S36. East bank of small ravine (NE NW SE 35, 2N-4W). Overburden: covered, moderate slope, with much sandstone float and silt locally visible, 15 ft. Limestone (St. Louis) dolomitic (?), dark gray and brown, poorly exposed, 2 ft.

S37. South bank of small stream tributary to Spring Creek just N. of road (Cen. S. line 2, 2N-3W). Overburden: glacial till, 10-20 ft., over massive sandstone (Pennsylvanian), 1.5 ft.; shale, interbedded with thin sandstone beds, 15 ft. Limestone (Salem) dolomitic, brown, fine grained, even textured, moderately porous, with many beds more than 1 ft. thick; outcrop intermittently covered; 18.5 ft., base covered by stream.

S38. Roadcut W. side along Hwy. 99 (NE NE NE 6, 2N-3W). Overburden: covered gentle slopes, 30 ft. Limestone (Salem) dolomitic, buff, fine grained and mostly thin bedded, 2 ft.

C35b. (Bleininger et al, 1912) Bank of Cedar Creek (E½ NE SW 8, 2N-3W). This outcrop could not be found, but it is said to have exposed 10-12 ft. of Burlington-Keokuk Limestone from which Sample C35b was taken.

C36. (Bleininger et al, 1912) Gully tributary to Spring Creek and S. of road, about 4 mi. E. of Camden (NW 11, 2N-3W). Overburden includes an unknown thickness of Pennsylvanian strata (See a nearby exposure S37). Limestone (Salem or St. Louis) only a few boulders of the limestone are now visible. No thickness was reported in Bleininger et al, 1912. Sample C36 apparently came from the boulders.

S39. North bank of Cedar Creek, ¼ mi. E. of Hwy. 99 (NE NW NW 17, 2N-3W). Overburden: glacial drift, 15+ ft., over cross bedded sandstone (Pennsylvanian), 3.5 ft.; covered, 40-50 ft. Limestone (Burlington-Keokuk) dolomitic, gray, coarse-grained fossil particles in variable amounts of brownish gray and fine-grained matrix, beds range up to 5 ft. thick; a few grains of quartz present, no chert observed, 7 ft., the base of the outcrop is covered by silt alluvium up to 10 ft. above the water level in Cedar Creek (Sample S39).

The chemical analysis of a sample taken earlier from this outcrop (C35a) is given in table 1.

S40. Bed in S. bank of stream 0.1 mi. N. gravel road and 1.75 mi. W. of Hwy. 99 (SE NW NW 31, 2N-3W). Overburden: glacial till, 20-30 ft., over covered, limestone (St. Louis) blocks abundant in soil for 10-15 ft. Dolomite (Salem) pinkish brown, very fine grained, glistening, in beds 6-12 in. thick, 4 ft.; dolomite, brown, fine grained, thin bedded, 7 ft.; over shale, 1 ft. Sample S40 represents the 11 ft. of dolomite exposed.

C34. (Bleininger et al, 1912) South side Missouri Creek, 4 mi. S. Camden (SW cor. 34, 2N-3W). The exposure could not be found, but sample C34 is said to have been taken from 8 ft. of brecciated St. Louis Limestone at this location.

S41. North side of road at bridge (NE NE SE 8, 2N-2W). Overburden: pebbly clay and silt, 6 ft. Limestone (St. Louis) gray, fine grained, nodular and jointed, lower beds wavy and contain algal structures, 3.5 ft. (Sample S41b). Dolomite (Salem) light gray and fine grained, in beds 2-8 in. thick, separated by 8 in. of shale, 4.7 ft. (Sample S41a excludes shale).

About 1/8 mi. N. of bridge no limestone occurs, as sandstone and shale (Pennsylvanian) filling a channel crop out.

C32. Gully next to road (NW 7, 1N-2W). This outcrop could not be found, but is described (Bleininger et al., 1912) as follows:

Limestone (St. Louis or Salem) conglomeratic, partly buff dolomite, 5 ft.; dolomite, bluish to buff, fine grained, somewhat nodular, 2 ft.; limestone, subcrystalline, irregularly bedded, 1 ft.; limestone, grayish, fine grained, shaly, becoming sandy toward the bottom, 5 ft. Sample C32 includes the upper 3 exposed units.

C31. (Bleininger et al., 1912) Bank of La Moine River, 3 mi. NW Ripley (NW cor. 19, 1N-2W). This exposure could not be found, but 5 ft. of St. Louis or Salem Limestone are said to have cropped out and sample C31 was taken from the limestone exposed.

S42. Hillside N. of creek (SE NE SW 26, 1N-2W). Overburden: covered, silt locally visible, 10-15 ft. Limestone (Salem) dolomitic, brown, fine to medium grained, porous, 2 ft.

S43. Southwest bank of stream (SW SE NE 27, 1N-2W). Overburden: covered, possibly glacial drift over sandstone (Pennsylvanian), 20-50 ft. Limestone (Salem) dolomitic, brown, few coarse-grained particles set in fine-grained matrix, porous, thin bedded at base, finely laminated, and brecciated in part, 9.5 ft.; limestone, dolomitic, with a few clayey beds 1 in. thick interbedded with gray, fine-grained, dull and silty dolomite, 1.5 ft.; limestone, dolomitic, dull gray to dark brown, mottled with black specks; silty, in massive beds which weather into large slabs, 3 ft. (Sample S43a). Sample S43 represents the upper 11 ft. of dolomitic limestone exposed in this bluff.

Fifty yards downstream, 2–3 ft. of similar limestone is exposed and believed to underlie the limestone sampled at the bluff. An abandoned quarry has been reported in the vicinity of this exposure, but it was not found.

S44. Lower part of hillside, NE of river (N½ NW SE 29, 1N–2W). Overburden: pebbly clay and silt, mostly covered, 50–60 ft., over white sandstone (Pennsylvanian), 4 ft.; chert pebble conglomerate, 1 ft. Limestone (St. Louis) gray, mostly fine grained and dull, some parts are oolitic, others cherty, 3± ft.

The chemical analysis of a sample taken earlier from this outcrop (C30) is given in table 1.

The upper surface is irregular and Pennsylvanian sandstones fill the depressions in the limestone surface. On the SE side of the hill, at approximately the same elevation as the limestone outcrop, there is an exposure of 3–4 ft. of brown, fine-grained dolomitic limestone in beds 1–1.5 ft. thick.

S45. Roadcut on new part of Hwy. 24, 1/8 mi. NE of bridge (SE NW NE 33, 1N–2W). Overburden: mainly silt, 6–8 ft., over sandstone (Pennsylvanian) 8–12 ft.; shale and sandstone, 6–20 ft.; cherty and limonitic conglomerate, 1 ft. Dolomite (Salem) light brown, fine grained, in massive beds up to 10 ft. thick, best observed around the hill and NW of the roadcut, 10–15 ft. (Sample S45).

S46. Exposures occur in two abandoned quarries S. of road and in deep gully E. of the quarries (NE SE NE 3, 1S–2W). Overburden: clayey silt, 14 ft., over sandstone (Pennsylvanian), 4 ft.; covered, 1.5 ft. Limestone (St. Louis) (observed only in the upper and western part of the W. quarry) siliceous, brownish gray, weathers bluish gray, somewhat brecciated, some beds thinly laminated and contorted, 4 ft. (Sample S46a).

Limestone (Salem) dolomitic, yellowish brown, fine grained, dull, thinly laminated with some green silty shale partings, and vertical veinlets of brown calcite, 5 ft.; shale, 1–2 ft. Limestone, dolomitic, thin bedded, with some chert in W. quarry, 3 ft. (Sample S46b). Limestone, siliceous, gray, oolitic, beds 4–5 in. thick interbedded with greenish gray silty and clayey strata, 2 ft. (Sample S46c). Limestone, light gray mottled dark gray, coarse grained, glistening, in beds 4–12 in. thick, 7 ft. (Sample S46d). Limestone, clayey and silty, medium gray, interbedded with greenish gray siltstone, 1 ft., base of exposure covered in W. quarry.

Additional strata are exposed in the gully a few yards to the E. and below the E. pit. Much of the section in the E. quarry, equivalent to the 7 ft. unit of limestone (S46d), is covered and below the floor of the E. quarry; however, the upper part of the stratum is visible and is distinctly stained brown and partly dolomitized. Below this is a 10 ft. covered interval followed by: dolomite, brown, fine grained, dense, in laminated beds 1–1.5 ft. thick, partly covered, 7 ft. (Sample S46e). Dolomite, brown, streaked with gray bands, mostly medium grained, porous due to leaching of fossil materials, in beds 5–6 ft. thick, containing a few siliceous geodes, 6 ft. (Sample S46f). Dolomite, brown porous, in beds 2–8 in., 2–3 ft. (Sample S46g), over dolomite, silty and clayey, medium dark gray, fine grained, weathers into thin slabs, 1.5 ft. (Sample S46h), base of exposure.

S47. Gully with small stream, ¼ mi. E. of Chicago Burlington and Quincy Railroad, and 1 mi. N. Browning (fig. 5) and Hwy. 100 (SE NE NW 23, 2N–1E). Overburden: covered gentle slope, many glacial boulders and pebbles in soil, one very large boulder of limestone (Pennsylvanian), probably from local bedrock, 5–25 ft. Limestone (Salem) dolomitic, brown, fine grained, porous, mostly dull, with medium and coarse fossil fragments, thin bedded, 9.0 ft. Two to three ft. of Salem Limestone is exposed 0.2 mi. NW of location S47 in a small stream bank. The stone is silty and thin bedded with its base covered.

S48. Stream cut bluff at bridge, 1/8 mi. N. of Hwy. 100, 1½ mi. NE of Browning (Cen. N½ 24, 2N–1E). Overburden: covered gentle slope, 10–30 ft. Sandstone (Salem ?) greenish gray, friable, with few mica flakes and quartz lined vugs, 1.5 ft., over covered, 9.0 ft. Limestone (Salem) dolomitic and siliceous, fine grained, with fossil molds, in beds 2–2.5 ft. thick, 6.0 ft. (Sample S48u); over covered, 2.0 ft. Dolomite, siliceous, grayish brown mottled with black specks, medium grained with some mica, 1.1 ft. (Sample S48m); covered, probably thin bedded dolomitic limestone, 2.6 ft.

Dolomite, siliceous, brown, slightly porous, in beds 10–12 in. thick, 4.5 ft.; dolomite, siliceous, grayish brown, fine grained, massive beds showing some spalling parallel to the bedding, 2.0 ft.; dolomite, clayey, fine grained, in beds up to 3 in. thick, 2.5 ft., base covered by stream alluvium. These latter three dolomite units are represented by Sample S48L.

S49. East bank of stream at junction with major gully (NE NW NE 24, 2N–1E). Overburden: covered forested slope, 15–30 ft., over massive sandstone (Pennsylvanian), 12–15 ft.; thin bedded, carbonaceous sandstone and shale, 4 ft.; overlying a discontinuous ironstone conglomerate and a calcareous shale, 4–5 ft.; calcareous, friable sandstone (possibly Salem) in beds 8–18 in. thick, 5 ft.

Dolomite (Salem) sandy, light greenish buff, in discontinuous beds, 1.0 ft.; in places locally dolomite, sandy, mottled gray and brown, in a bed 4–5 in. thick. Dolomite, sandy, gray, medium grained, glistening, finely laminated but in very thick beds, contains specks of white clay, 4.0 ft.; overlying dolomite, sandy, brown and gray, medium grained, in beds 3 ft. thick, 6.5 ft. Base covered by stream. Sample S49a was taken from the 12 ft. dolomite section of the Salem. The thickness of the bedding in the units described above varies since the dolomite is thin bedded in gullies about 50 yards to the N. and S. 17 ft. of sandy dolomite is exposed in a gully in the NW¼ SE¼ SW¼ sec. 13, T. 2 N., R. 1 E.

A ledge of jointed St. Louis Limestone 2.5 ft. thick, is exposed in the stream bed, 0.3 mi. upstream from S49. The limestone is brownish gray, mostly fine grained and even textured with a few very light buff nodules of chert that have green clay associated with them. Sample S49 is from this exposure.

S50. Abandoned quarry, 20 yards N. of Hwy. 100 on the E. side of the hill (NW NE SE 27, 2N–1E). Overburden: covered slope, 50–60 ft. About 15–20 ft. of Pennsylvanian strata are probably present. Dolomite (St. Louis) brown, fine grained, dull and dense, in thin discontinuous beds occurring in depressions of the limestone occurring below, 0–2 ft. Limestone, light gray and light tan, fine grained, nodular and jointed, coarse quartz grains present in the matrix in brecciated zones, 10–13 ft. (Sample S50).

Around the hill to the SW in the ravine at a slightly higher elevation there is an outcrop of cross-bedded limestone 3-4 ft. thick, underlain by 2-3 ft. of shale.

In the roadcut SW of the ravine: limestone (Salem or St. Louis) dolomitic, medium grained, consisting of fossil fragments surrounded by very fine-grained calcite particles, a few quartz grains, partly brecciated, partly covered, 6 ft. Underlain by limestone, dolomitic, fine grained, massive with worm-like structures containing limonite and calcite, 6 ft.

Sample S50a represents the above two limestone units which total 12 ft. in thickness. The exact relationship between these units is not clear as the exposure is poor. There may be a fault through this area displacing the limestones. The beds containing the worm-like structures have been observed at other localities to occur immediately beneath the beds in the quarry by the road. Wanless (1957, plate 1) shows these limestones as part of the Warsaw Formation; but, because of the predominate limestone and limestone breccia lithology, and as the thickness of the St. Louis and Salem in this area is at least 30 ft., the silty dolomitic limestones and shales of the Warsaw should be approximately 10-15 ft. below the elevation of the roadcut.

S51. North side Mill Creek near junction with Sugar Creek (SW NW NW 32, 2N-1E). Overburden: covered steep slope, 30-40 ft., over partly covered shale, 6 ft. Dolomite (St. Louis) light brownish gray, very fine grained and dense, in beds 6-24 in. thick, 8.0 ft. (Sample S51).

Approximately 9 ft. of similar dolomite is exposed on the SW side of Sugar Creek about 0.1 mi. SE of S51.

S52. Small bluff, N. bank at bend of Sugar Creek (SE NW SW 32, 2N-1E). Overburden: covered steep slope—at least 30 ft. of Pennsylvanian shales, siltstones and a 3-5 ft. bed of dark gray and dense limestone are probably present in this hillside as these rocks are exposed at this elevation in the next gully to the N., 35-45 ft.; siltstone, silty shales, and sandstones, 8-10 ft.

Limestone (St. Louis) greenish gray, fine grained, nodular and jointed with discontinuous bedding, some parts brecciated with greenish clay and silt matrix, 1-3 ft., base covered by Sugar Creek (Sample S52).

S53. Bed of Elm Creek, ½ mi. NW of Hwy. 100 (Cen. W½ SW SW 4, 2N-2E). Overburden: covered slope, probably about 20-30 ft. of glacial drift underlain by about 10 ft. of sandstone and/or shale (Pennsylvanian). Limestone (St. Louis) light gray and tan with reddish brown mottlings, fine grained, with many small joints, in irregular beds 2-3 in. thick, locally many algal structures giving rise to a very irregular upper surface of the stone; a maximum of 7 ft. is exposed above creek level.

S54. South bank of Coal Creek (SW SW SE 12, 1N-1W). Overburden: covered slope, 40-60 ft., over Pennsylvanian rocks: limestone, dark gray, mottled brown, nodular, poorly bedded and jointed, 4-11 ft.; shale, gray and buff, partly covered and interbedded with 1 ft. of coal, 10-15 ft. Limestone (Salem) dolomitic, brown, medium- and coarse-grained fossil fragments set in fine-grained matrix, variable porosity, in 1-15 in. thick beds. Total thickness exposed along S. side of Coal Creek varies from 6-15 ft. Underlying the dolomitic limestone is a gray calcareous shale, 1 ft.; creek bed and bottom of exposure. No sample of the dolomitic limestone was taken as the more massive beds are visually very similar to nearby and equivalent samples (S55 and S58a).

S55. Stream bed of gully just N. of road at small waterfall (NE SE NE 23, 1N-1W). Overburden: covered, dark gray silt visible locally, 15-35 ft. Limestone (Salem) dolomitic, brown, medium grained, in beds 1 ft. thick, even textured and dense, 6-9 ft.; limestone, dolomitic, brown, porous, alternating with gray dense fine-grained zones, 3 ft.; limestone, dolomitic, light gray, fine grained, dull, with traces of glauconite, contains many head-sized, quartz geodes resting on 2-3 in. of shale, 2 ft. Limestone, dolomitic, gray, fine grained, in beds 2-4 in. thick, 3.5 ft., base covered (Sample S55a). Sample S55 represents the upper three limestone units, totaling 11-14 ft.

S56. Upper part of Sugar Creek bluffs on S. side of road (Cen. NE NW 4, 1N-1E). Overburden: mainly silt with road bed immediately above, 4-6 ft. Limestone (St. Louis) gray, fine grained, brecciated, partly covered, 1.5 ft., over covered, 6 ft. Limestone (Salem) dolomitic, brown mottled with black specks, fine grained, dull, in beds 8-12 in. thick, 1-5 ft.

S57. About 20 ft. above creek level, N. side of Sugar Creek, 1/8 mi. W. of Chicago Burlington and Quincy Railroad, ½ mi. W. of Hwy. 100 (NW NW NW 4, 1N-1E). Overburden: covered moderate slope, 40-50 ft. Limestone (St. Louis) gray and tan, some reddish brown, fine grained with few coarse fossil fragments in irregular beds containing algal structures; some beds are brecciated, 7-10 ft. Possibly there is considerably more limestone present than is exposed as the top and bottom of the stone is concealed (Sample S57).

S58. Composite section of several exposures along S. and SW side of Sugar Creek (S½ 5, 1N-1E). Overburden: variable and dissected covered slopes, 10-35 ft., over shale and siltstone (Pennsylvanian), 6 ft.; siltstone and shale, 2 ft.; covered, 15 ft. In small gully in the NE SW SE there is 3-4 ft. of very porous, fine grained, brown dolomite exposed at about this level. Below it is limestone (St. Louis), exposed as irregular knob in knoll on SW bank of creek (W½ NE SW 5, 1N-1E), gray and dark gray, fine grained and nodular with numerous brownish gray calcite veinlets, 10-15 ft., base covered (Sample S58). Similar limestone is also exposed in the NE¼ SW¼ SE¼ of the same section in a 3-5 ft. bench just above the level of the floodplain. These two occurrences suggest the surface on which the St. Louis Limestone rests is uneven in this locality.

The section continues with 7-8 ft. of sandstone (Salem) near mouth of gully tributary to the creek (SE NE SW 5, 1N-1E). In bluff S. of the creek (SE NW SE 5, 1N-1E): covered, 5-10 ft.; dolomite (Salem) gray and brownish gray, fine grained, 3.5 ft. (Sample S58e); in places shale, dolomitic, greenish gray and silty, 8 in.; dolomite, siliceous, light gray and buff with green tinge, massive bedding, 3.5 ft. (Sample S58c). Siltstone, clayey and dolomitic, grades upward into the dolomite above, 5 ft.; dolomite, brownish gray, fine grained, porous, in beds 1-2 ft. thick, 9 ft. (Sample S58a). Base of exposure.

S59. In hillside N. side of road in small gully (near cen. NE 18, 1N-1E) and roadcut, near center of same section. Overburden: covered slopes, shale pebbles in soil suggest that shale (Pennsylvanian) bedrock may be present, 10-40 ft. Limestone (Salem) dolomitic, brown, fine grained, porous, in two beds 6-8 in. thick separated by thin, clayey, dolomitic beds, poorly exposed, 5 ft.

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